PAVING AND MUNICIPAL ENGINEERING

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

WILLIAM FORTUNE, Editor. - - - WILLIAM C. BOBBS, Business Manager

OFFICE: ROOM 44, CHAMBER OF COMMERCE, - - - INDIANAPOLIS, IND.

Entered at the Post-office, Indianapolis, Ind., as second class matter.

SUBSCRIPTION: { One Year, ... $1 00. Single Copy, ... 10.

FOREIGN SUBSCRIPTIONS.

Great Britain and Australia....6 s. sterling. | Austria.....4 florins.
France.....8 francs. | Germany.....6 marks.

Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

Vol. II. INDIANAPOLIS, IND., MARCH, 1892. No. 10.

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The columns of this publication are open to the discussion of all subjects relating to paving, sewerage, water-works, street-lighting, and the physical improvement of cities. Practical information as to the merits of materials used in such work and new methods, with photographs and drawings, which may be used for illustration, are especially desired. We are glad to get brief notes as to proposed improvements and the letting of large contracts.

City engineers are requested to send us as early as possible copies of their annual reports, which will be given proper notice.

Articles relating to methods of road making and maintenance are invited.

WHAT IS ASPHALT?

To the Editor of Paving and Municipal Engineering:

DEAR SIR—The quick and ill-considered reply of Mr. Gibson makes it necessary for me to occupy again, more space in your journal than I at first desired. I think it would have been much better if Mr. Gibson had waited a little while with his reply, until he had studied the subject on which he pleases to still further exhibit his utter ignorance.

It is absolutely a misrepresentation, when Mr. Gibson says, "that the coverings with the material *called asphalt* by me and the paving companies in America is not as generally satisfactory as those used in Europe." It is also absolutely untrue "that the proportion of good asphalt paving in America is much less than that of foreign countries, where the reputation of that material was made." Only want of knowledge makes such statements possible.

About thirty-four years ago the rock asphalt pavements were introduced in Paris and so great has been the general satisfaction, and its reputation, that in this short period of thirty-four years, the enormous quantity of about 1,000,000 square yards have been laid, in all of Europe, or about 30,000 square yards per year. About eighteen years ago the Trinidad asphalt pavements were introduced in the United States and during the eighteen years the small quantity of 9,777,868 square yards have been laid, or about 540,000 square yards per year against 30,000 in Europe. The Americans, of course, don't know what they are doing; they see so little of the world; very few have been in Paris or other European cities, and none have paid any attention to the asphalt pavements until Mr. Gibson, who knows so much about asphalt and asphalt pavements, was sent over to Paris for the purpose to enlighten the Americans. If the asphalt expert, Mr. Gibson, would have made inquiries about the prices the city of Paris pays for repairs of asphalt streets, he might have come to the conclusion the repairs must be very heavy, otherwise the city would not pay such big prices. I do not hesitate to state that the percentage of failures of repairs in the rock asphalt pavements is, if not greater, just as great as in the Trinidad asphalt pavements.

If Mr. Gibson wants to do something which would be of interest, and would not require great knowledge of asphalt pavements, let him report the prices the cities of Paris, London and Berlin pay for their asphalt streets. Let him state the time of guarantee; let him state the prices paid for repairs during the time of guarantee, and also the price of labor in the different cities. A comparison of these datas would be very interesting and show to the American public, how little they pay for their asphalt streets, compared to the high price of labor in this country, with European cities.

I do not believe Col. Haywood, engineer in chief of the city of London, nor Richard Kruger of Berlin, would thank Mr. Gibson for being quoted by Mr. Gibson as holding his views on asphalt. What Col. Haywood said about asphalt pavements in 1870, at a time when Trinidad asphalt, in its use for street pavements, was unknown, would not hold good twenty-two years afterwards, when he may have changed his mind. He certainly can't be as much behind the time as Mr. Gibson. As to Leon Malo, Delano and others, directly interested in the Seyssel mine, which furnishes the rock asphalt for the Paris pavements, I must confess I do not consider them authorities, as self-interest will induce them to call everything imitation which does not come from their mine.

I make this broad statement and defy Mr. Gibson to prove that I am wrong.

There is not one scientific authority, there is not one dictionary of note, not an encyclopædia, not a mineralogy or geology, which calls the bituminous limestone of Europe "asphalt." How could it be? When it is the universal theory that asphalt has probably been formed by the gradual oxidation of petroleum oils.

Rudolph Wagner, professor of chemical technology at the University of Wurtzburg, in his "Handbook of Chemical Technology," translated from the eighth German edition by William Crooks, F. R. S., New York, D. Appelton & Co., 1872, page 484, says:

"*Asphalt*—This material, sometimes known as bitumen, is a black, glossy, brittle resin, probably formed by the gradual oxida

tion of petrolium oils; it occurs very largely on the island of Trinidad, on the northern coast of South America, at the mouth of the Orinoco; on the water of the Dead Sea (anciently Lacus asphaltites) and in some other localities, viz., France, Seyssel, Department de l'Ain, *a limestone containing eighteen per cent. of asphalt* is found," etc.

Prof. E. Dietrich, at the Polytechnicum in Berlin, says in his book, "Asphalt Streets," on page 4: "The analysis of bitumen varies from—

Carbon	87.00 to	85.00
Hydrogen	11.20 to	12.00
Oxygen	1.80 to	3.00
	100.00	100.00

(Where is the limestone in this analysis?) and on page 5: "The asphalt lake in Tridad is one of the principal occurences," and further on: "*The bituminous lime rock is mined in Val de Travers, Seyssel,*" etc.

Prof. Adolph Pinner, in his Repetitorium of Organic Chemistrie, Berlin, 1886, page 301, says: "Asphalt or zudenpech is probably the product of the oxidation of petroleum-oils, is black, and melts at about 212° Fah. Prof. Leopold Gmelin, of the University of Heidelburg, gives a number of analyses of asphalts, among these two made by Frenchmen, in which carbonate of lime is not at all mentioned. They can be found in his Handbook of Organic Chemistrie."

	Regnault.	Ebelmen.		
	Meairo.	Bastennes.	Pont du Chateau.	Neapel.
	Per cent.	Per cent.	Per cent.	Per cent.
Carbon	80.34	84.54	76 41	80.62
Hydrogen	9.57	8.53	0.58	8.28
Nitrogen	.....	1.80	2 37	1.06
Oxygen	10.09	4.08	11.64	10.04
	100.00	100 00	100.00	100.00

	Boussingault.	Wetherill.	Stromeyer.
	Coxitambo.	Cuba.	Bentheim.
Carbon	80.34	82.67	86.68
Hydrogen	9.57	9.14	9.30
Nitrogen	.....	.....	0.66
Oxygen	10.09	8.19	2.82
Ashes	.....	.....	0.54
	100.00	100.00	100.00

The underlined names are the names of the places where the asphalt was found.

Gen. Q. A. Gilmore, A. M., in his "Practical Treatise on Roads, Streets and Pavements," New York, D. Van Nostrand, 1876, on page 174, says:

"Asphaltum is a variety of bitumen generally found in solid state; it is black or brownish in color, opaque, and has little odor unless rubbed or heated. It is found floating on the Dead Sea and in many places in Europe. Many localities in Mexico supply it, and it abounds in the islands of Barbadoes, Trinidad and Cuba, and in Ritchie county, West Virginia (This mine is exhausted—J. Sch.), also in New Brunswick, Dominion Canada. The limestone, *known as asphalt rock*, occurs in both Seyssel and Val de Travers. The stone is of liver brown color, irregular in fracture, massive, and has a specific gravity of 2.114. *It contains from five to fifteen per cent., sometimes twenty per cent. of bitumen.*"

In volume XVII, 1888 to 1889, "Transactions of American Institute of Mining Engineers," on pages 355 to 375, is to be found a lengthy article by F. V. Greene, New York City, in which asphalt is defined as bitumen. Capt. Greene gives, on page 374, as authorities for his definition of asphalt: Encyclopædia Britannica, Appleton's American Cyclopædia, Chambers's Cyclopædia, The Imperial Directory, Worcester's Dictionary, Watt's Dictionary of Chemistry, Ure's Dictionary of Arts, Bande & Cox's Dictionary of Arts, Rumpf & Mothe's Dictionaire, Larousse's Dictionaire Universel, Boussigdault's Annales de Chemie, Dana's Mineralogy and Geology. The closing words of Capt. Greene's article contain the following remarks: "Against these authorities stand alone Mr. Malo, Delano, and a few others, interested with them in the Seyssel mines, telling us that asphalt means a certain kind of limestone containing a certain specified amount of bitumen." To these last-named gentlemen we must add L. H. Gibson, on account of his profound knowledge on asphalt and asphalt pavements.

I stated in my letter of January 5th, 1892, that 99¾ per cent. of asphalt pavements laid in the United States were composed of an artificial mixture, and this is true, but Mr. Gibson's conclusions from this are entirely wrong. I did not say that an artificial mixture is inferior to the natural mixture. In how many cases has art succeeded in improving natural mixtures?

But let us see; is the rock asphalt found in such condition as to make an artificial mixing unneccessary? We know that the different stratas, in the same mine, Seyssel and Val de Travers not excepted, contain different percentages of bitumen. Only a certain percentage furnishes a good and lasting pavement, and in order to get this it is necessary to mix artificially the poorer with the richer bituminous lime-rocks. The overwhelming demonstration in which Mr. Gibson seeks to glorify, therefore, is no demonstration at all, when closely investigated. Mr. Gibson again glorifies, in his answer, in the failure of the American asphalt in Paris. Now, I wish to tell him that the Val de Travers asphalt, or bituminous lime-rock, failed conspicuously in the United States on Fifth avenue and Liberty streets, New York city, and on Pennsylania avenue, Washington, D. C., and has been replaced by Trinidad asphalt, while the sections on which American asphalt failed in Paris, were not replaced by rock asphalt, but one by wood pavement and the other by stone pavement. Can Mr. Gibson enlighten the world why? I would be just as ignorant as your correspondent on asphalt pavements would I come to the conclusion that these failures of rock asphalt in the United States proved that the streets were not laid with asphalt but with French imitations which are not good.

I mean precisely what I said: That the pressure of street-car tracks creates and constitutes a weakness in any asphalt pavement, no matter if rock asphalt or Trinidad asphalt has been used in its preparation. I further say that "the peculiar and enormously heavy traffic" referred to in my last is ruinous to any asphalt pavement and notwithstanding Mr. Gibson, Mr. Delano, of Paris, if he will give his honest opinion, will bear me up in this. If Mr. Gibson would study up on asphalt and asphalt pavements he would find that there is no difference of opinion between American and European engineers regarding asphalt, excepting the self-instituted authorities, Mr. Malo and Delano, of Paris, who, for reasons of self-interest, insist upon a difference.

New York, February 23, 1892. Julius Schubert.

MR. GIBSON'S REPLY.

To the Editor of Paving and Municipal Engineering:

Dear Sir—One point in answer to Mr. Schubert in the last number of Paving and Municipal Engineering was that experience shows natural asphalt to make a better street and one generally more satisfactory than that made from the artificial mixture which he claims is a real asphalt. I believe I proved this from Mr. Schubert's own statements. He said, with respect to the Rue de Rivoli incident, that the pavement failed because the company felt too confident of their ability to lay a pavement for heavy traffic, and that the presence of street car tracks, and "the peculiar and enormously heavy traffic" caused the failure. I asked Mr. Schubert if artificial asphalt is not suitable to uses next to or between street car tracks. He does not meet the question squarely as to the street car tracks. He says: "The presence of street car tracks constitutes a weakness in any asphalt pavement, no matter if rock asphalt or Trinidad asphalt has been used in its preparation." If Mr. Schubert has practically investigated the use of rock asphalt he knows that it is successfully used next to and between street car tracks in the large cities of Europe. There is nothing uncertain in what Mr. Schubert says about the asphalt to which he refers not being suited to "the peculiar and enormously heavy traffic." He acknowledges that it is not, but in doing so he

undertakes to pull other asphalt down with him. It is well that this acknowledgment be generally recognized. The writer, who traveled extensively, and who saw in the cities which he visited asphalt joined to street car tracks and under enormously heavy traffic, saw no failures, no evidence of decay where rock asphalt was used. He sees in cities in this country, he reads in the reports of engineers, many failures. The frank acknowledgment from Mr. Schubert as to what artificial asphalt will not do should be generally known. Either that or the manufacturers of the artificial mixture should set themselves square with the world as to the justice of Mr. Schubert's statements.

Mr. Greene, the vice-president of the Barber Asphalt Company, says: "Rock asphalt pavements began to be used in Paris in 1854, in London in 1869, and in Berlin in 1880, and its use has been continued with success." He also says: "The success of rock asphalt in Europe gave rise to a demand for such pavements in America, but the expense of the transportation of the rock from France was so great that inventors sought to find a substitute." Again: "A Belgian chemist conceived the idea of using asphalt with Trinidad as a cementing material. In this was combined sharp sand and a small amount of powdered limestone." This shows clearly enough the origin of the term asphalt as applied to artificial mixtures. It was to get something cheaper than the rock asphalt of Europe and sail it under the name of asphalt. The idea was conceived in a spirit of deceit. The expense of the original article was too great and the inventors sought to find a substitute. It is not the finding of a substitute that is to be blamed, but it is giving it the name of the original product.

Mr. Schubert says he would not consider Leon Malo and others interested as authorities, as self-interest will induce them to call everything imitation which does not come from their mines. The same logic would lead Mr. Schubert to condemn Capt. Greene, the vice-president of the Barber Asphalt Company, as altogether untrustworthy, yet he makes use of his name in this communication. However, I can not think that Capt. Greene is to be judged as without character in respect to asphalt merely because he is interested. His paper read before the Society of Arts in Boston is very fair. Mr. Schubert's statements can be questioned through Mr. Greene's statements in one little matter in his communication. Mr. Greene states that asphalt is a variety of bitumen found in a native condition and not manufactured, but Mr. Schubert does not quote this statement. I leave him to reconcile Mr. Greene's record in the matter of a definition of what asphalt really is with his own statements. Mr. Greene tells how the manufactured article became a necessity, how it was that the original material was a success. Then he undertakes, according to Mr. Schubert, to prove that the mixture is the asphalt and the original something else.

Mr. Greene says asphalt in the solid state is known commercially as *glauce* pitch. I mentioned Richard Kruger, author of "Handbook of General Street Building in Cities," who is one of the best German authorities of whom I know. Mr. Schubert neglects to condemn him because he differs from him. Likewise the "*Encyclopedia of Construction Moderne.*"

It would be impossible, in an article of this kind, to go into the record of failures of paving material. Any reader who is familiar with the history of artificial mixtures of which Mr. Schubert speaks, can supply his own illustrations. My original point, as to the artificial mixture, can be very easily sustained by observation. That one artificial mixture is not suited to connection with street car rails or unusually heavy traffic is affirmed by Mr. Schubert.

If Mr. Schubert would know what Mr. Haywood would think of my statements, let him read his more recent reports.

The uncomfortable personality which Mr. Schubert attaches to this discussion makes the handling of his matter a disagreeable task. The worst revenge which I can ask, because of this uncomfortable personality, is that the editor publish it all as he has written it. I am willing to accept the judgment of the public in all matters of this kind. LOUIS H. GIBSON.

PROFESSOR DE SMEDT'S VIEWS.

To the Editor of Paving and Municipal Engineering:

DEAR SIR—I have noticed in the January edition of 1892, of your valuable paper, a controversey between Messrs. Julius Schubert and Louis H. Gibson, as to the proper meaning of the term "asphalt." As Mr. Gibson asks for information, I will state my opinion which is based on our great standard authorities, and of facts of my own observation.

"Asphaltum," or "asphalt" is composed of different hydrocarbons, some of which contain also oxygen, nitrogen, and sulphur. Many chemists and geologists suppose it to be of a vegetable or mineral origin, while others suppose it to be an ejection of these substances which have been formed in the pyrosphere. Asphalt is also called pissasphalt when in a viscous state; mineral pitch, or Jew's pitch.

Natural bitumen is a generic name of a variety of hydrocarbons found in the earth, or exuding from it in the form of springs. The liquid varieties become inspissated by exposure and eventually hardened into the more solid form which is asphalt.

The foregoing conclusions are admitted by Humboldt, and by professors Old, Wurtz, Thenard, Dumas, Gerhardt, Boussingault, Raignaut, Lebel, Mund, and others, all of whom are scientific authorities here as well as abroad. They are all standard authorities and most of them are members of the French institute, "Academie des Sciences."

The term asphalt has been distorted from its true and primitive meaning in written specifications regulating the use of these materials in asphalt pavements. Thus some engineers have without any good reason called bituminous limestone asphalt, while the rational and technical name known to the scientific world is "bituminous limestone" or "bituminous carbonate of lime." It is composed, especially that used for paving purposes, of viscous bitumen, pissasphalt, and carbonate of lime. These natural mixtures vary relatively in their percentage often from one to forty per cent. of bitumen.

These two questions arise: *First*, where in these mixtures does the term "asphalt" begin and where does it end? And, *second*, ought not the term "asphalt" to be applied just as well to the natural mixture of sandstone and asphalt, viscous or hard. The proper name of this mixture is "bituminous sandstone;" we have also bituminous shales, etc. I have heard it remarked that it is called "asphalt" because it is a natural mixture, and not an artificial one. But that is childish and lacks argument, as any natural mixture can be duplicated, provided we are supplied with suitable materials and have the proper machinery to perform the work. Now, let us separate the two compounds—"bitumen" and "carbonate of lime." The bitumen pissasphalt being dissolved in chloroform or bisulphide of carbon, separated by filtration from the carbonate of lime and the solution being evaporated, the bitumen is left free. Thus the analysis has been made. We now make the synthesis by mixing the two preliminary composing parts in a suitable manner and on submission of this artificial mixture to pressure, we produce the identical rock asphalt as it was primitively, and yet this time it is an artificial mixture.

To manufacture artificially asphalt rock of as good a quality as the natural rock is easy enough. I will even state that the artificial mixture gains an advantage over the natural one, which is in its sure required percentage. It is, however, indispensable to have at hand the purest bitumen, suitable carbonate of lime and proper machinery.

This quality of pure natural bitumen, pissasphalt, being now in the market, no difficulty exists any longer to manufacture artificially the asphalt rock, should this mixture be preferred to the one composed of asphalt, heavy petroleum oil, sand and carbonate of lime, of which process I am the inventor. This latter mixture can be greatly improved upon; but in order to arrive at improvements in the line of asphalt pavements, the specifications used in

many cities must be changed; viz., instead of specifying "Trinidad asphalt" as the only asphalt acceptable for paving purposes, admission should be made to all asphalts equally good or of a superior quality.

Having thus endeavored to explain the true term of "asphalt," I will add that all pavements of natural or artificial mixture in which asphalt is the cementing matrix, are entitled to be called asphalt pavements. The question as to their relative qualities still remains an open one. E. J. DE SMEDT, *Chemist.*

New York, March 1, 1892.

AMERICAN AND EUROPEAN ROADS.

By Isaac B. Potter.

THE American farmer has nerve, vigor, ambition, industry good soil, good climate, and every natural facility for the successful pursuit of agriculture; but the average American farm is a lonely institution. Its owner is separated from his neighbors, largely denied the many social advantages which belong to people who are able to mingle with each other from day to day, kept at home from many gatherings, social, political and religious, from which he might receive both pleasure and benefit. His sons desert the farm for the more profitable and enlightened conditions of city life, and the allurement of profit which is held out in every community of successful farmers is not so conspicuous in the United States to-day as to entice our farmers' sons from the greater promise of success offered by mercantile occupations.

Farm property is no longer in active demand and investments which in other years would have sought the security afforded by farm mortgages are now directed in other channels. Go to any of the large cities of the Union and you will find upon the books of the real estate dealers an endless array of notices of farms for sale or to exchange for city property.

But I did not intend to digress. It will interest you to know more about the roads of France. In that country there is no such diversity between the material progress of the farmer and that of the merchant—between the country and the town—as is found in this country. The farmers prosper and have always prospered. Every dollar spent by the French government to bring itself more closely in touch with its rural population, has been well invested. You remember that terrible war when from Prussia, the King, the warrior and the statesmen led the German legions across the breadth of the French empire and forced the capitulation of Paris; and how the brave Frenchmen were humiliated by the exacting terms of peace which their conquerors imposed. The immense tribute demanded by the Germans at the close of that war, now twenty years ago, was made up from moneys contributed in a wonderful degree by the French farmers, and the admiration of the world which their patriotism excited in the payment of that tribute, was not greater than the wonder which everybody felt at the ready thrift which had enabled them to meet such enormous demands.

Here is a picture showing a valley near one of the small villages in the interior of France. The scene is about 50 miles northwesterly from Paris, not far from Amiens, which many years ago was a fortified city; but the ramparts have been torn down and replaced by splendid roadways, adding to the beauty and thrift of the city and to the convenience and pleasure of its people.

In the foreground you see a hard, smooth road. In the distance, running down from the hills and through the valley, you see a white line of road, showing the various directions in which these roads run and the uniform appearance which their hard finished surfaces present.

Of course these roads of France are not built by farmers who "work out" their highway taxes after the manner followed in this country, nor are they repaired by the use of plows, hoes or scrapers like those which are brought into use at the annual farmers' picnic which takes place when you go out to "work the road" in your township. On the contrary, they are built and kept up under a system which is perhaps the most perfect in the world. There is an official-in-chief, who takes charge of all the main roads of the republic and requires from his subordinates complete reports at frequent intervals. In this manner information is always at hand showing the condition of the roads in all parts of the country. Of course, the work is divided into different sections, which, in turn, are in charge of subordinate engineers or superintendents. Broken stone is furnished by contract, and considering the amount of labor accomplished each year on the French roads, the cost

is surprisingly small. The roads of our own states, at least the important roads, should be maintained in the same way. The inefficient, haphazard, and ridiculously expensive method which we have followed for the last hundred years, should have convinced us by this time of the necessity of change. Of course, I may be wrong about this, because it has never yet been determined just how long it takes a great and intelligent people to twist itself out of the rut of an accepted and established blunder. Upon this point, a keen and witty observer of public affairs says: "A hundred years is a very little time for the duration of a national error, and it is so far from being reasonable to look for its decay at so short a date, that it can hardly be expected, within such limits, to have displayed the full bloom of its imbecility."

When I write to you about these roads of Europe I know that you are apt to believe that these European countries are more wealthy than ours; that they are more thickly populated; more thoroughly cultivated; and that these splendid roads are built for the accommodation of only those farmers whose lands are highly cultivated; but in this you are wrong.

France is divided into eighty-seven "departments" or political divisions, which, in many respects, are not unlike our counties. In eighty-one of these eighty-seven departments the population per square mile is less that of the State of Rhode Island; in seventy-eight it is less than the population per square mile of Massachusetts; in sixty six it is less than that of New Jersey, while if you take the combined area of New York, Pennsylvania, Connecticut, Massa-

chusetts, Rhode Island and New Jersey, it will appear that the average population per square mile of these States exceeds that of seventy out of the eighty-seven departments of France. Many of these departments in France are less populous than the thickly settled countries in our western States, but the uniform excellence of the roads is everywhere maintained. Accompanying this article is a picture taken in one of the forests of France, where you see no signs of cultivation and where many of the best farms are in fact some miles distant from town.

You see in this picture the same excellent quality of road as that which appears in the ones I have already shown you.

Many years ago the French farmer had the same method of making and repairing the wagon roads that is followed in your county to-day. He quit farming for several days each year and "worked out" his road tax.

Do you think he could be induced to go back to the old style of doing things? Look at the picture copied from a photograph of a French road taken last year on the day after a heavy rain storm. The road surface is smooth and dry; the tall poplars on either side have been trimmed to the upper branches so as to let in the sun and air and hasten the drying of the road after a storm. Then notice the heaps of broken stone on each side of the road. These are used by the workmen in making constant repairs from day to day whenever the least imperfection appears.

In Belgium also the principal roads are built and maintained by the general government, and in 1880, in the nine provinces of Belgium over 79 per cent. of the highroads were of this class, the entire length of high-class roads being 4,173 English miles, out of a total of five thousand two hundred and eighty-six of roads of all classes. The best roads of Belgium are in the provinces of Namur, Liege and Luxembourg, and permanent employes are kept on the roads under the direction of the chief engineer of the province, for the purpose of insuring the observance of the regulations and looking after the constant repair of the highways.

In Baden the main roads are under the supervision of the State authorities, and are cared for with a studious regard for the requirements of the farmer and inland traveler. Under the law relating to roads in Baden, the duty of maintaining the road falls as follows: One quarter each upon the parish (town) and district (county) in which the road is situated. The remaining one-half upon the State treasury.

In Hesse-Darmstadt the roads are divided into two classes, called State roads and district roads, of which the former are a direct care and charge upon the general government, and when the district roads become so important as to require the attention of State officers, they can under direction of the district assembly ("Kreistag") be declared State roads. Every district is bound to appoint the necessary officials connected with the district roads. These officials consist of a skilled person who must be capable of filling the office of district overseer and a proper force of laborers requisite for the work in hand. Annual sums are allotted to each province out of the State budget to pay the cost of making and maintaining the public roads.

In Italy the Minister of Public Works is at the head of the Department of Public Roads. The construction of these roads is, in most cases, undertaken by contracts, the work being carried on under direction of government engineers. These contracts extend also to the work of maintenance and repair, and include the transport of materials, the cost of earth works, embankments, drainage, masonry, ironwork, stonework, removal of snow, mud and dust, and the care of border trees planted along the sides of the highways. The contractor is bound to deposit a fixed sum of money

COUNTRY ROAD IN ITALY.

in the hands of the public officials, to insure the performance of his contract, and on the termination of a contract, the road must be delivered up in perfect order and repair to answer the description contained in the specifications, and all defects becoming apparent within one month thereafter are made good at the cost of the contractor, under an estimate of the chief engineer of the district. The money deposit of the contractor is only returned to him upon the compliance of all the terms of his contract, and in case of his neglect or refusal to execute the orders conveyed to him by the highway officials, the latter have power to direct the necessary work to be carried on at the expense of the contractor. A repetition of such offense or the perpetration of any fault on the part of the contractor, results in the termination of his contract and the confiscation of his money deposit.

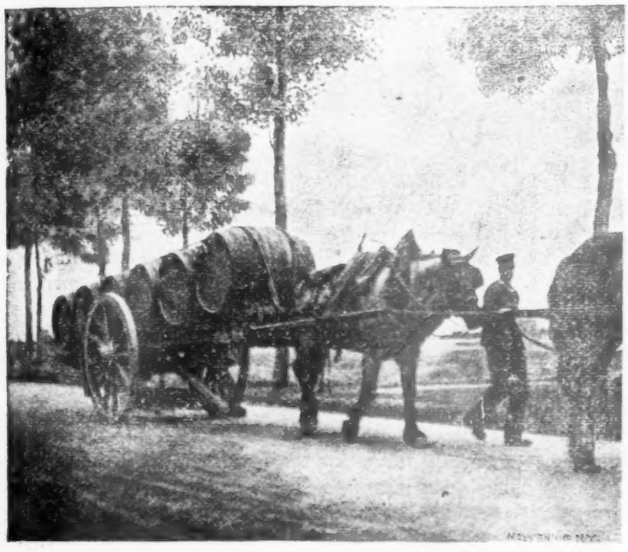
The government road laborers are called "Cantonniers," and are selected with great care, special reference being had to character and honesty. They must be of robust constitution and must be able to read and write. Each one of these cantonniers is provided with a full set of tools and implements specified by law. His

hours of work are from sunrise to sunset, and each day he is obliged to go over the entire track of road placed in his charge. He must be constantly upon the line of his work in all kinds of weather, and in case of necessity is bound to work on public holidays. His chief duties are the leveling and repair of the highways; the removal of snow, mud, dust, etc. He must assist travelers in distress and vehicles disabled by accident or by weather, and for any neglect of duty he may be fined, suspended or dismissed, according to the degree of the offense. The fines accumulated during the year are divided among the deserving cantonniers or given to one of the mutual benefit associations, of which they are members. Cantonniers who serve with credit and distinction for three or more years are promoted and given an increase of monthly wages. In the five years from 1873 to 1878, Italy spent about $16,000,000 on her roads, although before that appropriation was made, many excellent highways existed in all parts of the kingdom. In 1881 Italy constructed about 120 miles of new road and had then about 11,040 miles in course of construction. Mentioning the policy of the Italian government with respect to its maintenance of the public roads, Mr. Beauclerk, representing the British government at Rome in the year 1882, in his official report to the home cabinet, said: "It is therefore evident that the Italian government are doing their utmost to develop rapidly and extensively the means of communication in the kingdom, and there is little doubt that the large outlay incurred is fully justified by the increased prosperity and wealth of the country." At that time, something more than 5,000 miles of roads were in charge of the Italian government. More than twenty-five hundred cantonniers were employed and their services were devoted to the care of all the national roads, except five.

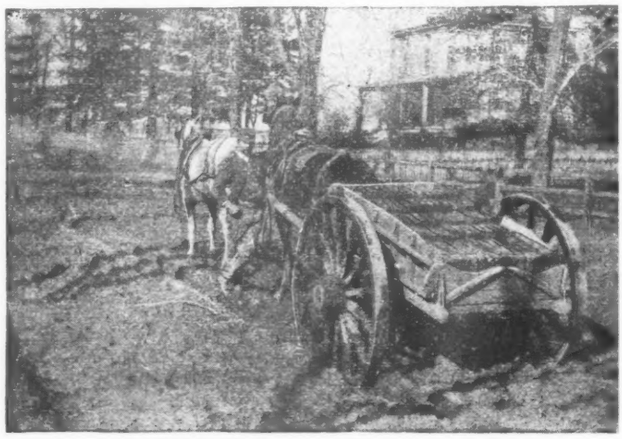
In the Netherlands, as in the countries already mentioned, the principal roads are maintained at the expense of the state.

In Portugal a similar rule is adopted. The state takes the responsibility of the construction, maintenance and service of all important roads connecting the provincial capital and the principal frontier towns. The director of public works and skilled engineers have the principal direction of the government work, relating to the common roads.

It is interesting to note that while some unimportant differences exist among European countries in the details of management and maintenance of the public roads, these countries are practically unanimous in their policy of placing the important roads under the direct management of the general government and of paying the



expenses of construction and maintenance out of the general funds of the state. The result has been most salutary. The splendid facilities for the moving of travel and traffic over these improved roads has proved the wisdom of placing the important roads under the care of skilled engineers and workmen, and the object lesson thus taught has borne fruit in the wonderful improvement of the provincial roads, which are maintained under management of the local authorities. It is no uncommon thing in France, Baden, Germany, Austria or Italy, to see loads, weighing in the aggregate from three to four times the load hauled by the ordinary farm team in our country, while the distances frequently traveled by the European draft horse with these immense loads are so much greater than the maximum attempted by the American farmer as to be almost beyond belief. I show you a picture



reproduced from a photograph, taken within the last year, upon one of the German roads. Here is a view showing a loaded two-wheeled cart, drawn by two horses, and bearing six large casks of wine, a load weighing in the aggregate several tons.

It needs only a casual view of this picture to show how easily this immense load is rolled over the smooth surface of the highway, and with what little effort the horses are able to perform their task. Thousands of miles of these roads exist in all parts of Europe; and so jealously are they regarded that no policy of state government seems to be in favor which does not include a proper care for the country roads.

Two-wheeled carts are in very common use among the farmers of Europe, just as they are in some parts of our own country. They hitch their horses one before the other in "tandem" style, and most of their heavy loads are hauled in this way. Now let me show you a picture of an American tandem work team with an American load on an American public highway. Here you have it:

This picture was taken within five miles of the public buildings of one of the largest cities in the United States. The load contains only four hundred bricks, which is considerably less than a fair load for one horse on a good road. The team has stopped to "blow," and double time is wasted in that way. These are the roads that make business unprofitable. They wear out horses, harnesses and humanity, kill patience, and keep you at the public house, when a better road would enable you to quicken your trip and save expense by dining with your family at home.

Your old friend, Horace Greeley, used to enliven his argument for better roads by relating the story of a farmer who took a drove of hogs a very long way to market, and found the delays and difficulties of his trip to be very expensive that he was compelled to dispose of his hogs at a considerable loss. On reaching home one of his enterprising neighbors who had some thought of trying the pork-raising business himself, asked him how much he had cleared in his enterprise.

"Well," he replied after some reflection, "I had the company of the hogs."

Now compare the Philadelphia picture (I really didn't mean to disclose the name of that city) with the last one before it, and take note of the fact that the German load is fully five or six times as great as the American load, and that this difference is due entirely to the difference between the road surfaces shown in the two pictures. You see there is no theory or guesswork in this matter which is not doubly proved by actual facts. You can't afford to

do business with no better hope of profit than "the company of the hogs."

In lower Austria, near Vienna, where the material for road-making is not found to be conveniently at hand, the government offered a very substantial reward a few years ago for the discovery of a solid and suitable substance which might be used in the improvement of the roads. The Austrians employ several thousand road cleaners regularly, together with a suitable number of inspectors, and maintain a system of continual repair, clearing off the dust and mud as fast as it accumulates, and repairing the slightest defect in the road, so as to prevent the formation of ruts.

In Hungary the state roads are under the management of the ministry of public works, while the country and parish roads are kept up by local management.

In Bavaria the government roads are made and kept in repair at the expense of the state, the money being voted by the legislative bodies of the Lantag. To prevent these roads being cut up a stringent law is enforced against the use of narrow wheel tires, and the width of the tire to be used is laid down as follows:*

Two	wheel	wagon	with two horses.....	4 inches.
Two	"	"	three or four horses	6 "
Four	"	"	horses	2½ "
Four	"	"	three or four horses.	4 "
Five	"	"	five to eight horses.	6 "

Carts having more than four horses, and wagons having more than eight are not allowed upon the public roads, except by special permission obtained from the authorities of the province. Fruit trees are planted along the sides of the roads under favorable conditions, and these are given into the care of the roadmen with permission to exhibit at the various fairs, where prizes are awarded for excellence of the samples.

MUNICIPAL ENGINEERING IN ST. LOUIS.†

By Robert Moore, C. E.

MODERN city government is in large measure a matter of municipal engineering, and that city is governed best in which this work is carried on with the greatest skill and success. As a contribution to the study of this most important branch of city government, a statement of the somewhat exceptional experience of the chief city of the Mississippi Valley in this line of work is worthy of record.

In the year 1875, . . . a board of thirteen freeholders, chosen by the people of St. Louis, was charged with the duty of framing a new city charter. The board contained a number of able and public spirited men, skilled in city affairs, and, as a whole, was exceptionally well fitted for its work. . . . The charter thus framed was ratified by the people; and on October 22, 1876, became the organic law of the city. In order to make clear the changes in the machinery and methods of municipal engineering effected by this new law, it is necessary to explain how this work was done prior to this time. . . . The city engineer was appointed by the mayor, subject to approval of the city council, and subject to removal or suspension by the mayor, with no restriction except that he must report the facts of the case to the city council at its next meeting. . . . He was to have charge of "all city improvements, works, repairs and buildings, and the performance of all contract for the same." He was also required to let all contracts for public work. . . . The council was expressly forbidden to let any public work or to fix the price or rate thereof. The engineer was also authorized, with the approbation of the mayor, to employ his own subordinates, and subject to the same approval to dismiss them. . . . This ample jurisdiction thus granted to the city engineer . . . was, however, subject to several important qualifications. First of all, he had nothing whatever to do with the city water-works, the entire control of which in all its departments was by special statute, vested in a board of water commissioners. . . . In the second place, in the department of sewers he had only a limited and subordinate jurisdiction. This department was in charge of a committee of the city council styled "The Sewer Committee," of which the city engineer was the chief executive officer, but not a member. . . . In all work of this class, he had no power except to carry out the instructions of the sewer committee. In the protection and improvemont of the harbor, and in the construction, repair, and cleaning of streets, his powers were more ample, and these were, in consequence, the chief fields of his activity. The changes in the organization of the city government made by the charter of 1876 were numerous, and some of them quite radical. . . . Most sweeping of all, however, were the changes in the organization of the municipal public works. By the new charter the offices of the city engineer, the sewer committee and the board of water commissioners are abolished, and in their stead is established a wholly new body, styled the board of public improvements, to the members of which, acting in part jointly, and in part singly, is committed the management and execution of all the city works. This body is composed of a president, elected by the people, and five commissioners, appointed by the mayor with the approval of the council. These commissioners are styled, respectively, the street commissioner, the water commissioner, the sewer commissioner, the harbor commissioner and the park commissioner. As individuals, each of these five commissioners is, by the charter and ordinances in pursuance thereof, made the executive head of the department indicated by his official title; and as such is charged with the execution of all contracts, and the enforcement of all ordinances relating to his department, and is responsible for all the acts of his subordinates. As part of this responsibility, all of his subordinates are appointed by the commissioner, . . . and all of them are removable by him at his pleasure. Each commissioner may himself be removed by the mayor or by the council for cause; but if removed by the mayor, the council appoints his successor; if removed by the council, his successor is appointed by the mayor without the concurrence of the council.

The president of the board in his individual capacity is head of the special tax department, and as such must make out and sign all bills of special assessment for street and sewer construction, and for street sprinkling. . . .

To the board of public improvements, acting as an organized body, is committed:

First. The letting of all contracts for public work, and the preparation of specifications and forms of contract therefor. A carefully drawn ordinance, prepared by the board, prescribes the rules to be observed in all lettings. The award, if any, must always be made to the lowest bidder, and the contract, when executed, is subject to the approval of the council.

Second. The preparation and recommendation to the assembly of ordinances for the following classes of public work:

1. For the opening, widening, construction, reconstruction, repairs and sprinkling of streets, and the making of all excavations therein.

2. For the establishment of sewer districts, and for the construction, repair, and cleaning of all public and district sewers, and the making of all sewer connections.

3. For the laying of water pipes, and the making of all attachments thereto, as well as the extension, construction and repairs of the water-works.

4. For the improvement, protection, repairing and cleaning of the levees, wharf and harbor.

5. For the improvement and maintenance of the public parks, and

6. For the erection extension and repairs of public buildings.

In this matter of the preparation of ordinances for public work, the board is in effect a third branch of the city legislature. With regard to street and sewer work, the charter in fact provides that

*These widths are here expressed in inches for the convenience of the American reader. They are reduced from the dimensions given in the Bavarian statute, where they are expressed in centimetres. The dimensions given above are practically the same as specified in the statute, the greatest variation being about one-tenth of an inch.

†Extracts from a paper read before the Boston Society of Civil Engineers.

no ordinances shall be valid unless first approved by the board of public improvements.

Third. A further duty of the board is the direction and management of the lighting of streets, alleys and public buildings, which is now done wholly by electricity; the superintendent of city lighting is an appointee of the board, and subject to its orders.

Fourth. To the board also is committed the management and control of the city workhouse, the superintendent of which, though appointed by the mayor, is subject to the orders and instructions of the board. . . . The organization of the new board was completed under the presidency of Col. Henry Flad. With the single exception of the water commissioner, the new commissioners, of whom the writer was one, were without previous experience in the special departments over which they were called to preside; but all were animated by an earnest desire to so organize and conduct the work committed to their charge as to secure the best possible results, and establish the new regime in the confidence of the people. That they were successful is the unanimous verdict. The public works of the city have been managed with economy and skill, and without the slightest suspicion of jobbery. City work is, in fact, as well and as honestly done as that of any private individual or corporation; so that, in cases where an option is given to the property owner to do work, such as sidewalk or alley paving, himself, or have it done by the city at his expense, it is found to be uniformly cheaper and better to have it done by the city.

The full control and responsibility given by the new system to each commissioner over his own department has naturally placed integrity and fitness at a premium in the appointment of subordinates to the disregard of political and other irrelevant considerations. Each has been free to organize and manage his force with an eye single to obtaining the best work, both in quantity and quality, and where this is done success is easy and certain.

Another thing, which has contributed much to the efficiency of the various departments, has been the opportunity of the commissioners to refer doubtful points of policy to the full board for advice and counsel. Backed by the prior indorsement of the board, they are thus enabled to take with safety responsibilities which they could not otherwise do without great danger of misconstruction, and consequent loss of public confidence. For a public officer must not only do right, but must also be thought to do so by the community whom he serves. . . .

As regards the matters committed to the board as a whole, it may be noted, first of all, that under the new system the letting of contracts for public work is conducted in a manner that leaves nothing to be desired. Every precaution is taken to put all bidders upon an equal footing. The character and quantities of the work are ascertained with the utmost care, and given in advance to all persons interested. All bids must be made upon blanks furnished by the board, and no bid is accepted unless accompanied by a certificate of the city treasurer that earnest money, amounting in some cases to ten per cent. of the estimated value of the work has been deposited with him. At the hour appointed the bids are all opened and read in a public meeting of the board. After a due time in which to canvass the several bids, the award, if any, is made to the lowest bidder, not the lowest and best bidder as under the former charter; but the board may, if it sees fit, reject all bids and order a new letting.

As heretofore carried out, this system of letting public work has given universal satisfaction, without even the slightest suspicion of favoritism or jobbery. That is to say, one of the most fruitful sources of municipal misrule has been completely removed.

In its legislative functions the success of the board of public improvements has been equally pronounced. The ordinances for public work recommended by them have been prepared with great care, so that when sent to the municipal assembly they have embodied the results of the best skill and judgment of every member of the board. Where ordinances originating with the board have been rejected by the assembly, it has never been because of any defect of form or method, but because of their unwillingness to do by any method the thing proposed. There can be no doubt that the provision requiring the assembly to pass or reject without amendment bills originating with the board has insured the city against technical blunders which would otherwise certainly have been made, and is eminently wise.

The wisdom of the framers of the St. Louis charter of 1876 has, therefore, been fully vindicated by the test of time, and the general plan of conducting municipal engineering work proposed by them is one which can be recommended without reserve to any large city.

The central ideas of this plan are:

1. The subdivision of the engineering work of the municipality into several departments, under the executive control of one man, who should be a man of strong character and mature judgment, and an expert in the special work under his charge.

2. The creation of a municipal engineering council, or board of experts, composed of the heads of the several engineering departments, co-ordinated under the presidency of an engineer of high rank, to which board all questions concerning the administration of the city works may be referred, and to whose special charge should be committed the letting of all contracts for public work and the initiating of all legislation concerning the same. . .

Of course it goes without saying, that neither this system nor any other, will give satisfactory results if committed to the hands of incompetent or corrupt men, although it will do much, even then, to limit the harm which can be done by any one man. But if carried out in good faith by the selection of capable and honest men as members of the board, this method of conducting municipal engineering work has several important advantages over the older method which in St. Louis it has superseded.

1. It avoids the absurdity of expecting any one man to be master of all the branches of engineering involved in the public works of the modern city, by subdividing the work to such an extent as to make it possible for the several commissioners to give to the problems of their own special work the concentrated attention and study necessary for their complete solution.

2. By centering in one man the executive control of each department, the highest degree of responsibility and efficiency is promoted.

3. By delegating to the board, composed of the heads of the several departments of public work, the preparation of all ordinances for such work, the city secures the great advantage of the matured judgment of a permanent and responsible body of experts.

4. The opportunity to present all matters of an unusual or doubtful nature to the full board, for record and for advice, is a most valuable resource and protection to the individual commissioner.

5. The placing of all lettings of public work in the hands of the board not only relieves the individual commissioners of work, in which the liability to charges of favoritism and malfeasance are the greatest, but insures the utmost publicity and fairness in the awarding of contracts, thus securing to the city the full benefits of open and honorable competition, and the services of the best class of contractors.

THE VITRIFIED BRICK STREET—THE PAVEMENT OF THE FUTURE.*

By H. L. Weber.

A VITRIFIED brick, or paver, as they are commonly called, is practically indestructible, and it is not known how long they will last in a pavement, from the fact that none that have thus far been laid have given out or shown the slightest signs of disintegration. We believe fifty years a safe estimate to give as its life, as the tests given herein will convince the most skeptical that THE MODERN PAVER, which is a vitrified brick, will last equally as long as iron blocks, and in the race for the best paving material, have distanced the granite, Medina stone, asphalt, or any other composition street. Of course there are different grades of paving brick manu-

* Extracts from a paper read before the Ohio Society of Surveyors and Civil Engineers.

facture, but you can select from the table of tests those that are standard, which will outlast any other known paving material.

* * * * * * * *

There are two methods of testing brick—by absorption and by rattling. The brick which will absorb the least water is the best. For the other test the brick is put in an iron cylinder at the Malleable Iron Works, and revolved fifty-four times each minute. Pieces of iron are also put in the cylinder with the brick. The brick that comes out of the ordeal without breaking is a good one, and the one that is worn the least is the best. * * *

Knowing something of the lasting properties of a vitrified paving brick, we come to some of the other advantages of this material; but before going farther let us call your attention to the fact that vitrified paving brick is but a few years old, and that a good many miles of street have been paved with many kinds of brick, good, bad and indifferent, during the past eighteen years, which is about the length of time brick pavements have been in use in this country. The eighteen years have perfected the vitrified paving brick, which can now be said to be past the experimental stage. It is certainly the coming material for paving our city and village streets, as well as our country roads.

Its redeeming features are many, and I will endeavor to give them to you in as short and explicit a manner as possible. The vitrified brick pavement is not as dusty as the asphalt, which is a great objection to the latter pavement. The brick pavement is certainly not as noisy as the asphalt, which is certainly a great objection to any pavement. Brick pavement is practically as smooth as asphalt, and WILL RETAIN a smooth and even surface, which no other pavement does so satisfactorily as brick. It is easily repaired, and when necessary to take it up for the purpose of tapping or repairing sewers, water or gas pipes, or for any other purpose, it can be done by ordinary workmen, while a limited number of skilled and high-priced workmen only can repair an asphalt pavement, and only then in certain kinds of weather.

It has been truly said that "the best pavement is the one most easily repaired." The necessary repairs to water and gas pipes should convince every one of this fact.

* * * * * * * * *

We have in the vitrified brick pavement the combined good qualities of the granite and cedar blocks, the ashler, the macadam the cobble stone, the gravel and the asphalt, without a single one of their objectionable features, and this, too, at a cost only a trifle in advance of the cheapest pavement (cedar block) as is shown by the following which was taken from a "table of averages from a compilation of the cost of these four leading paving materials in twenty different cities, which gives the following result: Granite, $3 per square yard; asphalt, $2.60 per square yard; vitrified brick, $1.75 per square yard; cedar block, $1.50 per square yard." Brick cost fifty-nine per cent. of granite, sixty-eight per cent. of asphalt, and 117 per cent. of cedar block.

It is evident from this that the twenty cities from which datas were obtained to compile the above averages, could by abandoning the use of granite, and substituting vitrified brick therefor, construct and perpetually maintain in perfect condition the street of the future, "a vitrified brick street," for the first cost of a granite street. For instance:

Cost of granite pavement per square yard	$3 00
Cost of brick pavement per square yard	1 75
Amount saved in first cost per square yard	1 25
Interest on amount saved for twelve years	1 26½
Total savings in twelve years	2 51½
Less cost of a new brick covering per square yard	1 15
Less cost of incidental repairs per square yard	11½
Total expenditures in 12 years per square yard	1 26½

Surplus saved the first 12 years per square yard, $1.25 and so on perpetually.

From the above it is evident that our cities and towns can construct and maintain a vitrified brick street at a far less cost than any other kind of material, and that twelve years does not represent its average life, but that time will practically demonstrate that twenty-five years will more truly represent the average life of our modern brick streets.

BURNING PAVING BRICK.*

By Henry Dawson, Sr.

IN THE first place a good quality of clay or shale is needed, and the next and most important thing to my mind, is to burn them thoroughly. I believe in taking plenty of time for burning paving brick. I have heard my worthy "brick brethren" tell of burning brick in so many hours, or in three or four days, and have gone home, dissatisfied with myself and my slow way, and have tried to rush my kilns through in a shorter space of time; but have always found it a failure. I have come to the conclusion that there is no such thing as burning a first-class vitrified street paving brick from our clay short of from eight to ten days.

In the first place, it is quite necessary to have the right kind of a kiln to burn with. For a vitrified brick, the kiln should not be too high nor too wide, and I do not think you can burn successfully with an up or down draft kiln alone. It is necessary to have an up and down draft combined to get from eighty to ninety five per cent. of good, hard top brick. I do not think it advisable to set them more than thirty brick high, as too much weight is apt to press them out of shape.

We know that clays vary a great deal, but I claim that lots of time should be taken in water smoking, and then heat up slowly till you get it to the right pitch and then keep it there. When the kiln has begun to settle it is very necessary that it should not be allowed to stop. For the first two days we do not let it settle more than one inch every twelve hours. After that, the kiln is well heated through and settles faster. We call fifteen inches a good settle for our clay. After you find your kiln has a good settle and you think there isn't a soft brick in it, burn it twenty-four hours longer. Of course I do not mean that, exactly; but you can do more harm by closing a kiln too soon than by running it too long.

I am a brick man and expect to make my living at that business as long as I live, and the more brick I sell the better I like it, but I do not want anything put into our streets and roads other than a good, tough, well vitrified brick that will last from fifty to one hundred years on an ordinarily traveled road without any repairing.

PAVING BRICK CLAY IN TEXAS.

PROF. E. T. DUMBLO, state geologist of Texas, has been investigating the question as to whether there is clay suitable for the manufacture of paving brick in Texas, and on the subject of the use and manufacture of such brick says:

"The rapidity with which brick pavements have grown in favor in the United States within the last few years has been wonderful, and the demand for brick has been so great that manufacture has scarce been able to keep pace with it. The result has been to jeopardize its popularity and usefulness, for manufacturers were so crowded with orders that they were enabled to put upon the market large quantities which were totally unfit for the use to which they were to be put, thus risking the killing of the goose of the golden egg. There is not much danger of a repetition of such an experiment in the future, for the great demand has not only led to improved machinery and the adoption of better methods, but to investigation and experiment which has disclosed the fact that material is far more abundant than was ever supposed, and in localities never suspected; in fact, 'that paving brick material can be found in the swamps and marshes as well as in the hills and bluffs,' so that now plants may be erected near to the place of use, that will produce a brick for paving purposes which will 'rival granite in durability, flint in hardness, and asphaltum in smoothness, cleanliness and ease on the hoof.'

*Read at Illinois Convention Brick and Tile Makers, January 19 and 20, 1892.

"The prime requisites of a good paving brick are

"1. That it shall have a vitreous body.

"2. That it shall be of sufficient toughness to prevent crumbling under the traffic.

"3. That it shall be free from pores, a dense mass which will not absorb the moisture, gases or impurities of the street or atmosphere.

"To secure these, the first essential is selection of a suitable clay; the second, proper preparation; and the third, skillful burning—burning to the point of thorough vitrifaction without risk of melting. Of these, the first may be said to come more particularly within my province, the other two pertaining exclusively to the practical operations of the manufacture; and yet, while practical experience, associated with intelligence, is beyond doubt a sure guide, the chemist may give the worker points of information which may save him or his employer many a good dollar. However, to the people the most important matter to determine now is whether they are suitable clays in existence near enough to the point of use to reduce the cost of freightage to a minimum, for this item of cost is generally the largest one, and not infrequently prohibitive. The 'long haul," so dear to the transportation company, is sometimes disastrous to the street paving enterprise.

"It is difficult to say in a few words what are the necessary component parts of a clay suitable for making a first-class vitr fied brick, and possibly it is true, at the present stage of knowledge, as some of the manufacturers hold, that an actual test in the kiln is the only conclusive solution in any given case. Nevertheless, it is equally true that we can tell by analysis when a clay will not make good brick, and it follows that analysis will also disclose whether there is any chance of its doing so. The chemist knows that the first requisite of "a vitreous body" is secured by the presence in the clay, the bases of which is the alumina and silica, of these ingredients with such fluxes as soda, potash, lime and iron in proper proportions; that the second requisite is made probable by the absence of such refractory properties as would render the brick too brittle; and that the third, impermeability, is best assured by the non-existence in the clay of elements which might be coverted into gas during the process of vitrifaction. Water would destroy usefulness by being converted into steam and leaving open the channel by which it makes its exit. This, however, is avoided by the process of preparations for the kiln, by thoroughly drying, pressing and re-pressing. Indeed, it is now held by the best manufacturers that re-pressing is a *sine qua non* of a perfect brick.

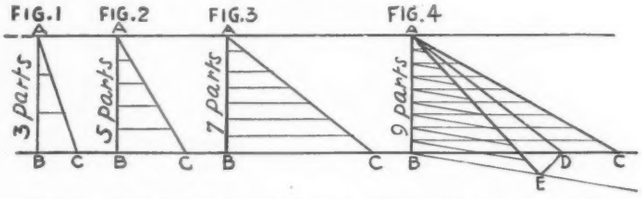
"I have taken the analysis of clays from three points outside of Texas—Bucyrus and Akron, Ohio, and Fort Smith, Arkansas—of which the best bricks are said to have been made, and used them as a standard for comparison with the analyses made in the Survey laboratory of clays from different points in Texas, and find that there are clays suitable for making vitrified paving brick in the counties of Smith, Harrison, Panola, Marion, Fayette, Henderson, Nacogdoches, Milam, Brazoria, Van Zandt, Kaufman, Wood and Harris, from some of which satisfactory results have already been obtained. All of these clays are not equally as good, but there is not one of them from which, with proper preparation and burning, good serviceable brick can not be produced, and the brick made from many of them will be as good, probably, as have or can be made anywhere. Up to this time no clays from the coal area of this state have been analyzed, and it is of this character of clay, or shale, that the best brick have hitherto been made. There can be little doubt, however, that when they are examined an abundance of the most suitable material will be found on the coal areas.

"When a bed of clay has been found which analysis leads to the belief is adapted to the purpose, the next step I would advise would be the sending of a sufficient quantity for a thorough, practical test to some manufactory which has a reputation established for the reliability of its products, far enough away to preclude the bias of self-interest to the result, or else near enough to have the benefit of that influence. This will secure an impartial trial and report. The result will then depend upon skill in the manufacture."

DIVISION OF KNOWN OR UNKNOWN DISTANCES INTO EQUAL PARTS.

To the Editor of Paving and Municipal Engineering:

DEAR SIR—I send you a problem that may be useful to mechanics, also to young engineers, viz.: How to divide any known or *unknown* distance AB, into any number of equal parts, say 3, 5, 7 and 9 equal parts, so as to avoid fractions.



Place a two-foot carpenter's rule diagonally from A to C, as here represented. For Fig. 1 make AC some multiple of 3, say 9 equal parts or $\frac{9}{8}$ of an inch, foot or yard, and prick off $\frac{3}{8}$, $\frac{6}{8}$ and $\frac{9}{8}$ as the proper spacing. Fig. 2, make AC$=\frac{5}{4}$ and prick off $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$ and $\frac{5}{4}$ of an inch, foot or yard, as the case may be. Fig. 3, make AC$=\frac{7}{4}$ and prick off $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$, $\frac{5}{4}$, $\frac{6}{4}$ and $\frac{7}{4}$ on rule or scale for proper spacing. Fig. 4 make AC$=\frac{9}{4}$ or $\frac{18}{8}$ and prick off a $\frac{1}{4}$ or $\frac{2}{8}$ inch on rule each time. Now draw lines from the said points of division parallel to BB or BE. Cutting the vertical and unknown distance AB into the required number of equal parts and the thing is done. This avoids troublesome fractions and the "thumb rule" of spacing with a pair of compasses or dividers.

If in Fig. 4, we use an engineers' scale when the inch is divided into 10 equal parts, then $\frac{18}{10}$ on AD or AE will accomplish the same thing as $\frac{18}{8}$ on AC, that is, will divide AB into 9 equal parts. Similar reasoning will apply to all the figures. Now, suppose the line AB is just 1 inch, then in Figs. 1, 2, 3 and 4 the inch is divided into thirds, fifths, sevenths and ninths respectively. Thus, by this mode of scaling, we can get at any part of an inch very easily. Recollect that AC, AD or AE must be some number of equal parts just reaching from A to C or to D, or to E, as the case may be, and exactly divisible by the number of parts you wish to divide AB into.

F. R. LOCKLING, City Eng'r.

LEGAL DECISIONS OF INTEREST TO CONTRACTORS AND ENGINEERS.

Assignment of Municipal Payments by Contractor.—A contractor with a city gave a bank an order directing the city to deliver to it all warrants on account of the contractor's work. The contractor then gave written orders on the bank to pay certain sums to certain of his creditors. These were presented before the warrants were delivered to it and placed on the file under a parol agreement between the bank, the contractor and the payers of the orders that the bank, after reimbursing itself for the advances to the contractor out of the proceeds of the warrants when collected, should apply the remainder in payment of the orders in the order in which they were presented, unless retained by legal proceedings. Under the agreement the orders were an equitable assignment of the fund to be received on the warrants, and therefore the bank could not be charged with such fund as garnishee of the contractor in favor of a mere creditor of his. *McDaniel* v. *Maxwell*, Sup. Ct. Ore., 27 Pac. Rep. 952.

Construction of Sewer Contract.—One Murphy constructed a sewer for the city of O., the contract price being the sum of $28,045.40. Payments were made from time to time, so that when the work was accepted on October 3, 1888, there remained due the contractor the sum of $7,551.50, and 5 per cent. of the total contract price, viz., $1,402.27, to be held six months. The principal, without interest, was afterward paid. In the absence of a contract to the contrary, the contract price, less the 5 per cent. was due upon the acceptance of the work, and that the contractor was entitled to 7 per cent. interest upon the amount due, until it was paid. Likewise that he was entitled to interest on the 5 per cent. fund held in reserve after the expiration of six months from October 3,

1888, until it was paid. *Murphy* v. *City of Omaha*, Sup. Ct. of Neb., 50 N. W. Rep. 265.

Engineers' Classification of Work by Agreement.—Defendants were contractors for certain construction on a railway, and contracted with plaintiff to do a portion of the work. Plaintiff was to receive twenty-five cents per cubic yard for removing loose rock, and seventy-five cents for solid rock, the classification to be made by the chief engineer of the railway, or by one appointed by him for that purpose. Plaintiff commenced work, and then notified the local engineer in charge of the work that unless the job were classified as solid rock he would abandon it; whereupon the engineer so classified it, and the plaintiff completed his contract. A member of defendant firm was present during the work, and knew of the classification shortly after it was made, and told the plaintiff it was all right. Defendants were liable on such classification. *Ricker* v. *Collins*, Sup. Ct. of Texas, 17 S. W. Rep. 379.

TRINIDAD ISLAND'S SUPPLY OF ASPHALT.

THE Trinidad pitch-lake concession has been extended for an additional year on the original term of twenty-one years from February 1, 1909, for every $20,000 paid by the concessioners before February 1, 1909, over and above the minimum sum of $700,000 payable in the first fourteen years, and the $140,000 to be paid for the seven years' extension from February 1, 1902. The Trinidad Asphalt Company has also agreed that if, by February 1, 1892, it had not paid to the colonial government $500,000, in addition to the $50,000 permanent deposit in London, the company would give to the Crown a mortgage on all land it now possesses in Trinidad as collateral security for the balance then remaining of the $700,000. The Governor of the island complains that many persons are still illegally obtaining from government land or shipping from private land to which they have no title inferior asphalt, which injures the reputation of Trinidad asphalt in New York, or it has to be purchased by the Barber Asphalt Company to prevent it being laid on American streets.

DON'T TURN THE EXHAUST INTO THE SEWER.

STEAM should never be put into a brick or cement sewer, as it has an injurious effect on the same, causing disintegration and collapse within a very short time; neither should it be led into a brick chimney for the same reasons. In some places it is the practice of the engineers to turn the exhaust from pump or small engine into the sewers, but this is bad practice, and, we believe, an illegal act in some cities, for it will not only destroy the sewers, but the heat of the steam makes the malarial gases more active, while at the same time it produces a certain amount of pressure that will force the gas back into buildings through the water traps commonly in use. In these traps there is seldom more than three inches of water, and very little pressure is necessary to force the gas through them. Wherever gas is forced back through buildings in this or a similar manner, the death rate in that locality will certainly be greatly increased.—*The Stationary Engineer.*

STEAM HEAT FOR STREET-CARS.

STREET-CAR heating by steam pipes is being tested on the Third avenue line in New York. Two 5 inch pipes run under the seats and are connected by two cross pipes so as to form a complete circuit. Inside each 5-inch pipe is a smaller and shorter pipe nearly filled with brine. Under each large pipe are gas burners consuming about 10 cubic feet of gas per hour. Before leaving the depot the space about the inner pipe is charged with steam from a stationary boiler, the brine cylinder acting as a heat reservoir. Without the gas burners the heat thus supplied will be maintained for about three hours. The cost per car is said to be 25 cents per day with the gas burners and 10 cents per day without.

IMPROVEMENT OF RAILROAD AND STREET CROSSINGS.

DR. J. F. EDGAR, of Lexington, Ky., offers the suggestion that where railroads cross city streets the crossing can be improved by filling the space between the ties with concrete, six inches in thickness.

HOT ROLLS FOR ASPHALT.

IN nearly every city of Europe one finds slightly varying methods for putting down asphalt. In Leipsig after pugging it in the usual way they run a medium heavy roller over it which is heated very hot by a coke fire inside of it. This roller is about three feet in width and of about the same diameter, and the rim of cast iron is about an inch and a half thick. Inside of this roller is suspended a basket which is filled with burning coke, the roll being turned from time to time to keep the entire cylinder hot, very hot. Thus the weight and the heat of the roll are communicated to the asphalt in the same operation. In Leipsig, the other operations of putting down asphalt are not greatly different from those of Paris and other cities. The pugging with hot cast-iron rammers and other operations are practically the same. The asphalt used is a little darker color than the material used in France and of a slightly inferior quality, so acknowledged. It is from Hanover. It is adjudged a good paving material, though not rated the highest.

Another mechanical method for communicating heat and pressure to asphalt is in use at times in Berlin. There are heavy rammers which are heated very hot and which, by a mechanical contrivance, are raised and allowed to fall at regular intervals on the asphalt as it is dragged over it. This does measurably the same work as is done by hand during the pugging operation. This machine has certain advocates who claim that it is quite superior to the hand operation, not alone in the character of the work done, but in the cost of it. This machine might, in our vernacular, be called a mechanical pugger.

CORK PAVEMENT.

A NEW material for paving is now being introduced in London. It is composed of granulated cork and bitumen pressed into blocks, which are laid like bricks or wood paving. The special advantage of the material lies in its elasticity. When used for pavement it gives a soft tread which is exceedingly pleasant, recalling the feel of a carpet. In roadways it furnishes a splendid foothold for horses and at the same time almost abolishes the noise which is such an unpleasant feature of city traffic. A short piece of pavement is to be seen in Liverpool street, E. C.; while the outlet to Pickford's yard in Gresham street is laid with this material. It yet remains to be seen how it will bear the ordinary traffic of a London street, but there is evidence to show that in Australia short pieces of roadway have given good results.

JAPANESE ROAD LAW.

JAPAN has had good roads for some centuries, and the Kioto-Tokio highway, 307 miles long, was noted for its excellence as long ago as 1691, when it was traveled by the Dutch explorer Kaemfer. But as their new civilization introduced new vehicles of traffic, the Japanese, in 1875, framed new laws for the general construction and maintenance of highways. This law, by which all roads are classified, is modeled somewhat on the French system and divides them into national, prefecture and village roads. The national roads are built and kept in repair by the State, the work being done by the prefectures along the line. The second class of roads is kept up at the joint expense of the State and the prefectures, each paying one half. And the village roads are built and maintained by local taxation under the engineering authority of the prefecture. The administration is said to be excellent, and what money is expended is in the line of efficient work.

A NEW PAVEMENT.

A NOVEL form of street pavement is at present being tested at Frankfort-on-the-Main, Germany. On a foundation layer of beton is placed a network of flat iron strips about 40 mm. (about 1½ in.) deep, and into the interstices of this network molten asphalt mastic is poured. This arrangement is supposed to do away with the objectionable influence of high summer heat on ordinary asphalt paving, and it is further claimed to give a better foothold to horses. It is somewhat suggestive of the recently much-talked-of Monier system of arch construction. The cost of the new pavement, as might be expected, is said to be rather high.

Improvement and Contracting News.

PAVING.

Minneapolis, Minn., has forty miles of paved streets.

At Ottumwa, Iowa, North First Avenue is to be paved.

Creston, Ia., will lay about two miles of paving this year.

Second street, Memphis, Tenn., is to be paved with brick.

The streets of Fayetteville, Ark., are being macadamized.

Des Moines, Ia., will pave East Grand avenue with brick.

The prepared estimate for paving at Moline, Ill., is $27,193.

Middletown street, Bucyrus, Ohio, will be paved with vitrified brick.

The town of Rye, N. Y., will issue $10,500 in bonds for road purposes.

The city council of Predmore, Minn., talks of paving the streets in the spring.

The board of public works of Detroit, Mich., desires $601,870 for paving this year.

A vitrified press brick pavement is to be laid on Greenwood Ave., at Trenton, N. J.

More than a mile of new sidewalks will be built in the spring at Park Rapids, Minn.

The city council of Newark, N. J., has voted in favor of $500,000 of street paving bonds.

There is a movement on foot to put down vitrified brick pavements at Cloverport, Ky.

The paving of Main street, Helena, Mont., is to begin as early as the weather will permit.

Plans are being prepared by the council of Braddock, Pa., for the paving of several new streets.

Messrs. Brennan & Nutter will pave Main street, Newark, Ohio, with brick from Zanesville.

Third street, Dayton, O., is to be paved from the river bridge on the west to Sears street on the east.

East Main and South Erie streets at Massillon, Ohio, will be paved with fire brick in the spring.

Considerable cedar block paving will be done at Winona, Minn., as soon as the weather will permit.

The city council at Hagerstown, Md., has decided to appropriate $27,000 for the improvement of streets.

About 10,000 square yards of granite block paving will be laid on North Peters street, New Orleans, La.

Sherman and Grant streets, at Oakland, Cal., are to be improved by the California Improvement Company.

Sixth street, Louisville, Ky., is to be paved with vitrified brick. George W. Gosnell has the contract.

A. M. Smith, of Greensboro, N. C., has a $50,000 contract for paving, with Belgian block, in Asheville, N. C.

It is proposed to pave and otherwise improve Watkins street, Brooklyn, N. Y., at an estimated cost of $27,000.

Thirty thousand dollars is to be expended for improving the public road between West Chester, Pa. and Paoli.

The total estimate for paving Somerville and Webster avenues with granite blocks, at Somerville, Mass., is $98,780.

James Reilly will pave twelve blocks on West Walnut street, Springfield, Mo., with brick at a cost of about $20,000.

The street committee estimates that it will cost $17,974 to concrete sidewalks in the village of South Hadley, Mass.

Councilman Wunderlich advocates the paving of Spring and other streets with vitrified brick at New Albany, Ind.

The board of public affairs at Springfield, O., is considering estimates for paving with brick, aggregating nearly $115,000.

Twelfth street, at Columbus, Ga., is being macadamized. Crushed stone are being scattered evenly with a layer of sand on top.

Raleigh, N. C., will pave with Belgian blocks the streets subject to heavy travel, and others will be macadamized to the city limits.

The paving of South Broadway with fire brick from Main street to the city limits at Lexington, Ky., has been ordered by the council.

The total cost of the macadamized road on Broadway, Long Branch, was $44,404.40; the total number of square yards paved was 14,930.

At New Castle, Ind., the council has decided to pave the sidewalks with brick on North Elliott street and the street itself with asphalt.

Preparations are now in progress for the completion of the Main street pavement at Urbana, Ill. Brick is being laid on that thoroughfare.

The council of East St. Louis, Ill., has ordered that Broadway be paved with granite, between the bridge and the viaduct, at a cost of $25,000.

Thos. Oliver & Sons were awarded the contract for a Medina stone improvement on Achilles street, Rochester, N. Y., at a cost of $2,494 88

It is stated that the boulevard between Dinuba and Orosi, Cal., is an assured fact. The road will be widened to 75 feet in the spring and also graded.

Ordinances have been signed by the mayor of Baltimore for the paving of Broadway with sheet asphalt and Eutaw street with asphalt blocks.

The property owners along Broad street, Augusta, Ga., are greatly opposed to macadam being laid on that street, and favor either asphalt or Belgian block.

The board of supervisors of Augusta county, Va., has recommended the passage of a bill authorizing the county to issue $150,000 in bonds for road improvement.

Center, Second, and Spring streets, around the government building at Little Rock, Ark., are to be paved. Brick are also being laid on Rock street, and Congressman Terry has introduced a bill in the House appropriating a sufficient amount to build a turnpike from the city to the National Cemetery.

The city of Wilmington, Pa., will begin in the spring a three years' campaign of paving to cost $490,699. Principally granite blocks and fire brick paving will be laid.

Alliance, Ohio, now has about seven and one-half miles of improved streets, paved with macadam and brick. Three and three-fourths miles were paved during the past year.

A contract for paving Middletown street, from Lane to East street, and East street, from Middletown street, Bucyrus, O, was awarded to J. G. Frayer, at a bid of over $5,000.

The annual report of E. H. Reed, superintendent of streets of Cambridge, recommends better paving for that city. The expenditures last year amounted to $111,371.15.

There is a strong likelihood now of Peachtree street, Atlanta, Ga., being paved with asphalt. They have a petition signed by everybody on the street urging the council to take such a step.

The report of the board of public works of Duluth, Minn., will show last year to be the greatest year for public improvements ever known in Duluth. Something over $900,000 was expended in public improvements.

Alex. McCurdle received a $455.19 contract to grade Broadway between Clough and Catlin avenues, Superior, Wis., and Keiver & Burke were awarded a $9,455.77 contract for grading Catlin avenue, Winter and Belknap streets.

Since January 1st, petitions for improving twenty-eight streets in the section of the north end streets west of Old Tacoma, Wash., have been acted on by the council and contracts are now let for grading all but five or six of them.

Wedgewood avenue, Nashville, Tenn., a thoroughfare sixty feet wide, is to be graded by J. C. Quinn from Ridley avenue to the railroad crossing. When completed it will make one of the most desirable drives in the suburbs of the city.

The largest contract let in West Duluth, Minn., for street improvement was awarded to Paddy McDonald for the improvement of Fourth avenue at about $130,000. E. F. Mitchell has also been awarded the contract for improving Grand avenue.

Extensive street improvements are being made at Linda Vista, Cal. 3,500 lineal feet of cement sidewalks has been contracted for on Walsworth avenue, Bayo Visia avenue, and Santa Clara avenue. Walsworth avenue is also being macadamized.

The board of public works of Indianapolis, Ind., has decided to pave with asphalt Pennsylvania street from Sixteenth to Seventeenth streets; Virginia avenue from Washington to Maryland, and Massachusetts avenue from Delaware to College avenue.

The clerk of council of the city of Keokuk, Iowa, will receive sealed proposals until noon, April 4th, for grading, tiling, curbing and paving Main street from the east line of Second street to the west line of Eighth street. Approximate quantities are: Paving, 17,554 yards; grading, 14,000 cubic yards; curbing, new, 4,000 linear feet; curbing, old reset, 240 linear feet.

The laying of Belgian block pavements at Atlanta, Ga., is being executed with rapidity, and several of the principal streets are already estranged to mud and mire.

J. H. Finnegan was awarded the contract by the board of public works of Cincinnati, O., for paving, with asphalt, Freeman avenue at a bid of $43,806, and also Eighth street, from Broadway to Vine, with the same material at a bid of $27,856.

New pavements are projected at Detroit, Mich.: Beaubien street from Brady to Ferry streets; Second avenue, to the boulevard; Leverette street from Seventh to Twelfth streets, and Eleventh street from Michigan avenue to Leverette street.

The streets about the depots and grounds of the Terminal Company at Portland, Ore., are to be put in good shape. John Burke was awarded the contract by the company for over 5,000 square yards of stone block pavement on H street, Seventh street and G street.

The board of public works of Indianapolis has approved and allowed street improvement estimates for Coburn street, between East and Madison Ave., amounting to $10,635.92, and Meridian from Palmer to the Belt Road, amounting to $13,828.80.

City Engineer Mansfield, Indianapolis, will recommend that the paving specifications hereafter shall ask for bids on the Parkhurst combination curb and gutter. It is said to enhance the beauty of paved streets very much, and is made of Portland cement and sand.

Major James H. Dooley has prepared a bill to authorize the city of Richmond, Va. to issue 4 per cent. bonds for the purpose of making permanent improvements and to lay a special tax upon the abutting owners to meet the interest and redeem the principal of the bonds.

Pittsburg's streets will be paved as soon as the weather will permit and councils have passed the ordinances. The supreme court has decided that the new street law is good and Chief Bigelow, of the department of public works will make preparations to begin the work in early spring.

The directors of the street and sewer department have prepared a schedule of all the streets in the city of Wilmington, Del., that need paving. Three hundred and fifty thousand dollars is the total amount required to pave the streets on the schedule, which amount is about equally divided between the eastern and western portions of the city. Of course the work can not all be completed during the coming season, but as many streets as possible will be paved. The material to be used will most likely be granite block, although it has not been decided upon as yet.

The commissioners of Peoria, Ill., make the following report as to the estimated cost of improving various streets in that city: South Adams street, Bridge to Cedar, $43,309.09, brick; High street, from Main to Elizabeth, $13,073.06, asphalt; Franklin street Jefferson to Adams, $5,274.78, brick; Main street, from Elizabeth to Bradley street, $23,303.17, brick; North Jefferson street, from Wayne to Abingdon streets, $45,961.44, brick; Main street, from North to Elizabeth street, $9,211.86; Main street, from Crescent avenue to North St., $1,879.87, brick; Main street, from Bluff St. to Crescent avenue, $5 215.98, brick; Main street, from Water to Bluff street, $59,577.80, brick; South Washington street, from Apple to city limits, $26,128.30, brick; alley through block 10, $1,304 54, brick; Illinois avenue, from Knoxville to Buckner avenue, $18,289:06; Moss avenue, from Malvern street to Western avenue, $24,592.24, asphalt; making a total of $277,123.19 for street paving, with probably the addition of several other streets. The council also passed estimates to the amount of $64,743 for sewers.

SEWERS.

Mansfield, Ohio, is to have a new sewer system.

Columbus, O., will lay $125,000 worth of sewers.

Sandusky, O., will expend $30,000 for sewers.

A new sewer will soon be laid on Ninth street at Oakland, Cal.

The council of Alton, Ill., has voted to construct several sewers.

Plans are being prepared for a complete system of sewers for Beaumont, Texas.

Rapid progress is being made on the Parkhill avenue sewer at Yonkers, N. Y.

Thirty thousand dollars' worth of sewers will be built at Hancock, Mich., before next fall.

Forty-five thousand dollars has been appropriated for a brick sewer at Nashville, Tenn.

Ten thousand dollars' worth of sewer extensions are about to be made at Dunmore, Pa.

Sewer contracts aggregating $9,190 at Winnipeg, Man., have been awarded Clark & Connelly.

City Engineer Hoff will give details of a proposed sewer system to cost $57,000 at Reading, Pa.

Bids will soon be received for the construction of about 25,000 feet of sewers at Akron, Ohio.

Plans for ten miles of sewers have been made and the contracts for five miles let at Racine, Wis.

The town of Nantucket, Mass., has voted to spend $50,000 for laying of sewers along the water front.

Forty thousand dollars is the estimated cost of the proposed south end brick sewer at Richmond, Ind.

A main sewer on Alpine street, Newark, N. J., is to be constructed. City Surveyor Adam can furnish particulars.

Middletown, O., will petition the legislature for authority to issue $30,000 worth of bonds to build sewers and streets.

A member of the city council of Whatcom, Wash., states that the city will put in $200,000 worth of sewers this year.

Worcester, Mass., has appropriated $88,000 for sewers and $35,000 for street construction during the ensuing year.

The city of Fall River, Mass., will petition for authority to issue $350,000 in bonds for street and sewer improvements.

Engineer McCann furnished plans and specifications for a sewer in the Hackensack plank road, West Hoboken, N. J.

The board of sewer commissioners has been authorized to issue $10,000 in bonds for the purpose of extending the outlet sewer system at New London, Conn., further into the river.

Ordinances have been passed by the council of N. Baltimore, O., for the improvement of Second and Third streets by sewers.

The main sewer on Twelfth street and Circle avenue, at Harlem, Ill., is now about finished. The cost is something like $61,000.

Anthony Lee received the contract for 300,000 sewer brick at $7 per thousand by the council committee of Minneapolis, Minn.

Until March 29th, sealed proposals will be received for the improvement of Beckett street, Cincinnati, Ohio, by constructing sewers and drains.

An election will be held at Meridian, Miss., on June 24th to vote on the issuing of $75,000 of bonds for the construction of a sewerage system.

W. Sargent, of Chicago, has presented plans and specifications for a sewerage system for Benton Harbor, Mich., which have been adopted.

A large storm water sewer in Forest Park, St. Louis, Mo., is being planned, work to commence during the coming summer; estimated cost, $15,000.

Hornellsville, N. Y., has voted in favor of a sewer bill, which provides for an expenditure of $100,000 to construct a system of sewerage for the city.

A thorough and complete system of sewerage to be followed by street paving at Crawfordsville, Ind., has been determined upon by the council.

Kenosha, Wis., has advertised for bids for the construction of 2,564 feet of sewers, to be constructed with twelve outfall, manholes and fifteen catch-basins.

Fries & Barr, of Greenfield, Ind., were awarded the contract for laying a 24-inch pipe sewer, 600 feet long, on Stone and West streets, at New Albany, Ind.

A cylindrical brick sewer, two feet inside diameter and four-inch shell, is to be built in Monroe street, Michigan street, Sixth street and two alleys, at Toledo, O.

W. E. McClintock, of Boston, is preparing plans for a system of sewerage for Bath, Maine. The length will be about twenty miles and the cost above $50,000.

The council of Birmingham, Ala., has voted in favor of a joint sewerage system between the city and the town of Highlands. Twenty thousand dollars is the estimated cost.

The complete sewerage system proposed for Nantucket, Mass., is estimated to cost $161,276. Ten miles of pipe will be needed and it is intended to have the work completed by June 15th.

The sewerage committee of Fort Dodge, Iowa, has concluded to recommend C. F. Loweth, of St. Paul, to make a survey of the city and furnish plans for the putting in of a system of sewerage.

Plans and specifications for a system of sewerage have been adopted by the council of Santa Fe, N. M., for that place. $2,500 of bonds will be issued for beginning the work, yet the estimated cost of the entire system is $105,000.

The general sewer specifications as heretofore approved by the council of Benton Harbor, Mich., were ordered printed at the last council meeting, and S. C. Sharpe, the clerk, was instructed to receive bids to be opened on March 21st at 7:30 P. M.

Sealed proposals will be received until March 22 for the construction of the main sewer on Cedar street, Owatonna, Minn.

The specifications for a vitrified brick sewer on Maryland street, Evansville, Ind., were accepted and the board of public works ordered to advertise for bids for the sewer, to be completed May 1st.

The city of Benton Harbor, Mich., has advertised for sealed proposals, to be received until March 21, for the construction of sewers of the following dimensions and distances: 656 feet of 12-inch sewer pipe; 785 feet 15-inch sewer pipe; 805 feet 18-inch sewer pipe; 310 feet 20-inch sewer pipe; 1,250 feet 36-inch brick sewer; 360 feet 40-inch brick sewer; 1,825 feet 48-inch brick sewer. S. C. Sharpe, city clerk.

WATER-WORKS.

Bellevue, Ohio, possesses its own water-works, which cost $60,000.

Water works are projected by the business men of Kosse, Texas.

Medicine Lake, Wash., has voted to issue bonds for water-works.

The town of Rochester, Ind., is agitating the question of water-works.

The town of Shippenburg, Pa., has voted to put in a system of water-works.

The water mains at Streator, Ill., will be extended so as to supply Kangley, Ill.

It is proposed to extend the water-works to the newly annexed ward at Rutland, Vt.

Syracuse, N. Y., will issue water bonds to the amount of $500,000 for the new works.

A Lansing firm received the contract for constructing the water-works at Cassopolis, Mich.

The city of Manchester, N. H. will purchase 520 tons of cast-iron pipe for water-works.

The water commissioners are considering the enlargement of the reservoir at Amsterdam, N. Y.

The water-works company at Greensboro, N. C., will increase its plant by the addition of machinery.

Fitchburg, Mass., has applied for authority to increase its water supply and to issue $300,000 of bonds.

The city of Berryville, Va., has been authorized to borrow $15,000 for the construction of water-works.

Plans and specifications are authorized to be prepared for the construction of water-works at Lacon, Ill.

An ordinance has been signed giving E. B. Lake and others the right to construct water-works at Ocean City, N. J.

T. A. Hardman received the contract for erecting the system of water-works at Olney, Ill. His bid was for $20,960.

The water-works company at Sharon, Pa., has voted to increase its capital stock by $50,000 to meet cost of extensions.

Sealed proposals will be received until April 6th for constructing and maintaining a system of water-works at Greenfield, Ind.

Bonds are to be issued at Crestline, Ohio, for the purpose of enlarging, improving and extending the local water-works system.

Steps are being taken to secure authority to build new water-works at Cincinnati, Ohio, and issue $6,000,000 of bonds to pay for them.

The town of Greeley, Neb., will erect, own and run a $16,000 water-works plant. Work will begin as soon as the weather will permit.

The water-works commissioners at Harrisburgh, Pa., have recommended the purchase of a 10,000,000-gallon high duty pumping engine.

A fund of $20,000 is now available for the construction of water-works at La Grande, Oregon, and work will soon be commenced.

D. G. Adelberger, of Baltimore, has completed a survey for the proposed $10 000 system of water-works to be built at Middletown, Md.

At Spokane Falls, Wash., water and municipal bonds to the amount of $1,200,000 have been sold to Farson, Leach & Co., Chicago and New York.

It is reported that a company is willing to build water-works at Sheffield, Mass., provided a guarantee of 4½ per cent. upon the investment is secured.

The bill of Assemblyman Webster, authorizing the city of New York to spend $500,000 for new pumping engines for the water-works, has passed the senate.

The necessary steps have been taken for getting a bill passed by the legislature enabling Willoughby, Ohio, to bond itself for $30,000 to put in a water-works plant.

The water-works committee of Redwood, Minn., has contracted for, and obtained the perpetual right, and use of the water from the springs a mile from town.

The council of Van Buren, Ark., has accepted the proposition of the Southern Improvement Company of Dallas, to put in water-works under a twenty-five years' franchise.

Two of the boilers at the Marion (Ind.) water-works have been condemned by the Indiana State Boiler Inspector, and the water-works trustees have advertised for bids for two new ones.

A committee of the council of Ludlow, Ky., have petitioned for right of way to lay water mains through West Covington to enable them to make connection with the Covington water mains.

At Carthage, Mo., the water-works company is laying 2,000 feet of mains in the Carthage Improvement Company's addition. An order for mains on South Garrison avenue has also been made.

BRIDGES.

Antauga creek is to be spanned by a new iron bridge at Prattsville, Ala.

The proposed bridge over the Cowlitz at Weston C. H., Wash., will cost $40,000.

The 800-foot bridge over the Colville river, west of Colville, Wash., has been completed.

Three bridges will be built over the Muskingum river at and in the vicinity of Zanesville, Ohio.

A new wagon bridge is to be built across the river at Prophetstown, Ill., to be completed by the first of next July, at a cost of $18,000.

A bill has passed the lower House authorizing the construction of a bridge at Burlington, Iowa.

There is talk of building an iron bridge across the Colorado river near Eagle Lake, Texas, to cost $25,000.

Work has been commenced on the bridge that is to span the gulch on North I street at Tacoma, Wash.

The board of public works at Spokane, Wash., was instructed to prepare plans for a bridge on Olive street.

There is talk of constructing another $30,000 bridge across Rock river to connect Sterling and Rock Falls, Ill.

It is thought that the bridge across the Mississippi at Memphis, Tenn., will be open for traffic by the first of May.

The county commissioners have ordered a bridge over the Scioto river at Grand View avenue, Columbus, Ohio.

A bridge will be built over Thirty-first street at New York City to connect the San Carlo with the Grand Hotel.

The commissioners' court has passed an order for the building of an iron bridge over the Llano river at Llano, Texas.

Mr. Mould's bill, appropriating $5,000 for repairs to Casterland bridge in the town of Croghan, N. Y., passed the Assembly.

Engineer Force is preparing plans for the rebuilding of the Main street bridge at Cleveland, O., as soon as spring opens.

The senate has passed Senator Parson's bill appropriating $10,500 for widening the canal bridge at Monroe avenue, in Rochester, N. Y.

The proposed new bridge from Covington, Ky., to Cincinnati, Ohio, when completed will be one mile or over in length, and sixty feet wide.

The bridge across the Colorado at Marble Falls, Tex., has two spans up, and when completed will be one of the best bridges in the Lone Star state.

The Senate of New Jersey has passed a bill giving the consent of New Jersey to build a bridge over the Delaware river between Camden and Pennsylvania.

The old Tenth street bridge over the Monongahela river at Pittsburgh, Pa., is to be replaced by a handsome structure, to cost between $250,000 and $300,000.

A Pennsylvania company has received the contract for the new iron swing bridge across the Clinton river at Mt. Clemens, Mich., at a consideration of $9,400.

The county commissioners of Tippecanoe county, Ind., have instructed Surveyor Cory to prepare plans and specifications for a bridge over the Little Wea.

The Missouri Valley Bridge Company has begun the construction of the county bridge over Slate creek at Patton's Ford, a few miles southeast of Wellington, Kan.

City Engineer Banks has completed his estimate of the proposed bridge between West Superior, Wis., and West Duluth, Minn. The total cost of the structure will be $110,000.

The Youngstown (Ohio) Bridge Co. will construct an iron bridge 85x26 feet over the crossing of the Nashville and Chattanooga Railway at Cherry street, South Nashville, Tenn., in consideration of $6,000.

The commissioners' court of Galveston county, Texas, has ordered an issuance of $175,000 of bonds for the purpose of providing funds to construct a bridge connecting the island with the mainland.

At Ottumwa, Iowa, the bridge being constructed at Market street will be completed early in the month of June, and it is expected that the electric cars will be running over it not later than the Fourth of July.

Newton and Flushing, N. Y., have been granted permission by the board of supervisors to build an iron bridge over Flushing creek at a cost of $30,000. Work will be commenced as soon as specifications can be prepared and contracts made.

Sealed proposals will be received at the office of the county commissioners of Pulaski county, Hawkinsville, Ga., until March 22d, for removing the fixed iron highway bridge across the Ocmulgee river and constructing in its place an iron or steel draw-bridge.

Arrangements have been completed between the Chamberlin Pontoon Bridge Company and the city council for a pontoon bridge across the Missouri river at Chamberlin, S. D. The location of the bridge and various other details have been adjusted and work will commence at once.

STREET LIGHTING.

An electric plant will be erected at Hartford, Ky.

An electric light plant is to be erected at Colborne, Ont.

A movement is on foot to establish an electric light system at Huenme, Cal.

The merchants of Bowling Green, Ohio, are organizing a company to build an electric light plant.

It is proposed to issue $20,000 in bonds and build a municipal electric light plant at Carthage, Ohio.

E. J. Nellis can give information in regard to the erection of an electric light plant at Bridgeport, Ala.

A petition is in circulation asking the town of Manchester, Conn., to appropriate money for an electric light plant.

Messrs. Stratton & Burke, of Decatur, have asked for a franchise to establish an electric light plant at Monticello, Ill.

The mayor of Jefferson city, Mo., has called a special election to vote on the proposition for electric lights for that city.

W. W. Taylor, of Philadelphia, is president of an electric light company to furnish electric lighting to Egg Harbor City, N. J.

A company has been formed at Far Rockaway, N. Y., with capital of $25,000, to establish an electric light plant at that place.

Mobile, Ala., wants bids for the erection of an electric light plant of 200 arc lights capacity; also for lighting the city with 180 lamps.

The council at Northfield, Minn., is contemplating the question of establishing an electric light station at that place to be owned by the city.

The city council at Eagle Grove, Iowa, has voted in favor of electric lights, and a plant to cost about $20,000 will be put in by eastern capitalists.

The council of Rochester, Minn., is agitating the electric question, but the mayor vetoed a bill to appropriate money to pay a committee to investigate.

The capital stock of the Olean electric light company at Olean, N. Y., has been increased from $30,000 to $35,000 and general improvements are to be made.

The legislature will be asked to authorize the city of Annapolis, Md., to issue $90,000 for the construction of an electric light plant and other improvements.

The citizens of Cleveland, Ohio, are discussing the matter of asking the legislature to pass a bill authorizing the issue of $1,000,000 bonds for an electrical plant.

A twenty-years' franchise has been secured by J. G. Iverson & Co., from the city of Glencoe, Minn., who will put in an electric light plant there as soon as spring opens.

The Asbury Park Electric Light and Power Company, at Asbury Park, N. J., is arranging to extend their plant. The proposed extension includes two boilers, new engine, dynamos and other machinery.

The council of Boone, Ia. has granted an extension of 20 years to the charter of the Boone electric light company and the business will be enlarged by the addition of a $30,000 arc light plant and the city streets will be lighted by electricity.

The Edison Electric Lighting Company, of Chicago, will enlarge its plant. It is said that it will dispose of its present plant on Adams street, and will build the most gigantic plant in the world; ground for which will cost over $500,000 and the plant fully $1,000,000 in additi[illegible].

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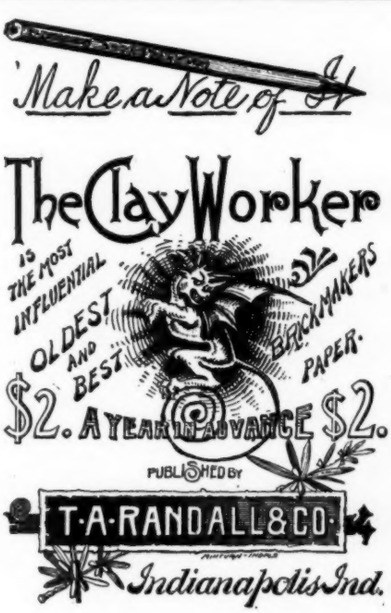
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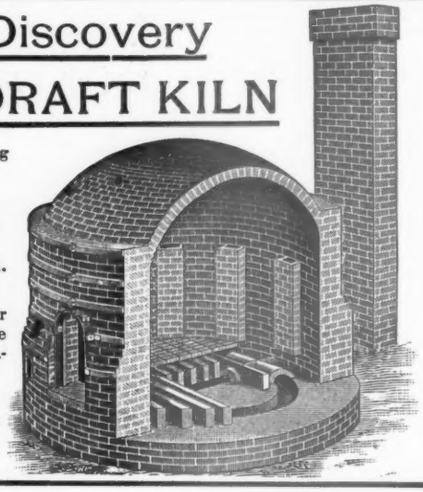

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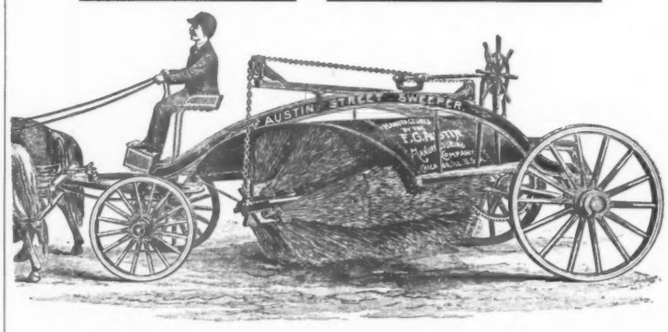

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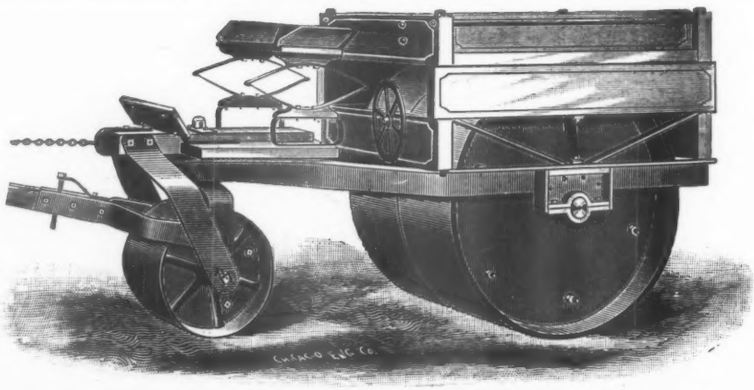

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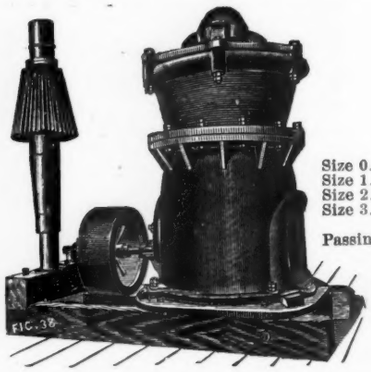

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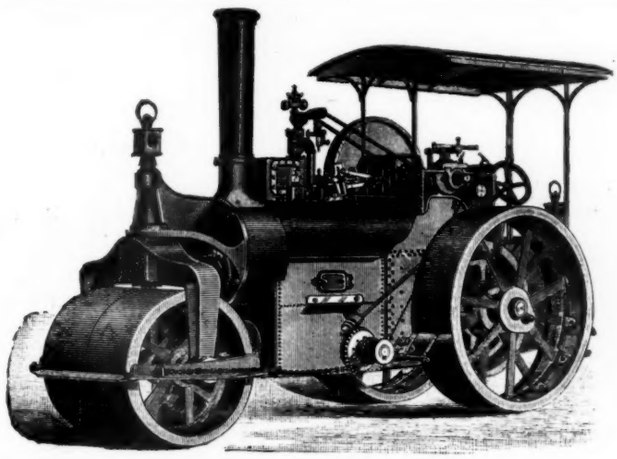

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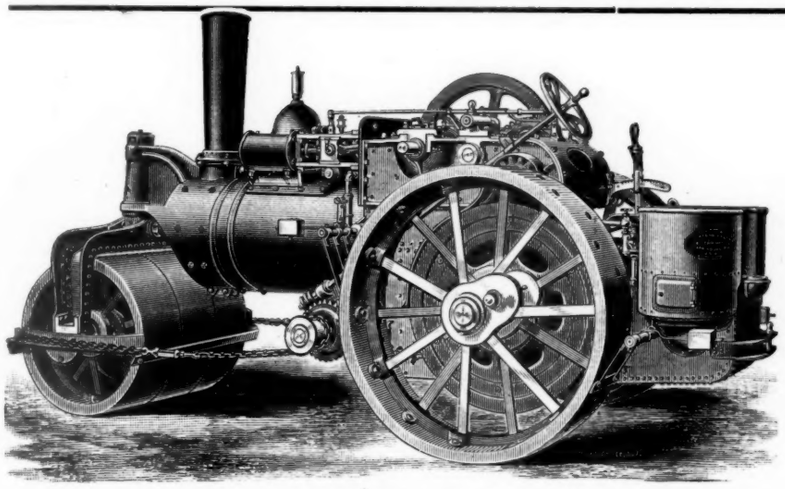

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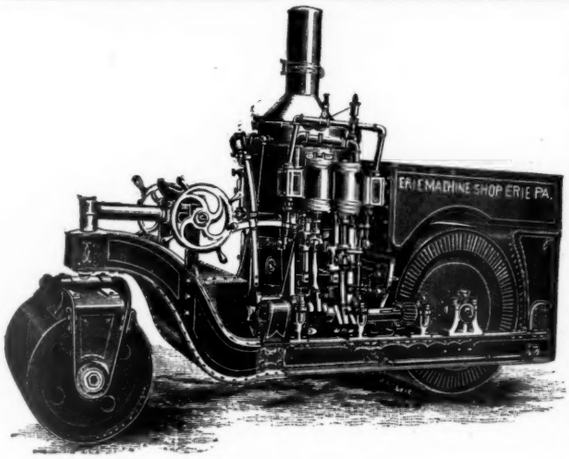

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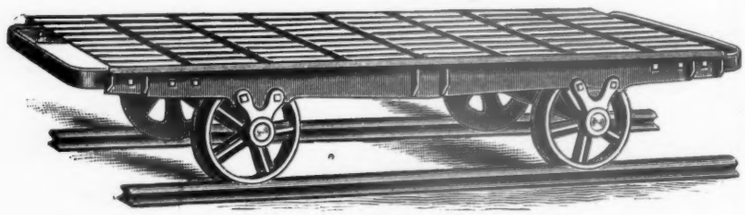

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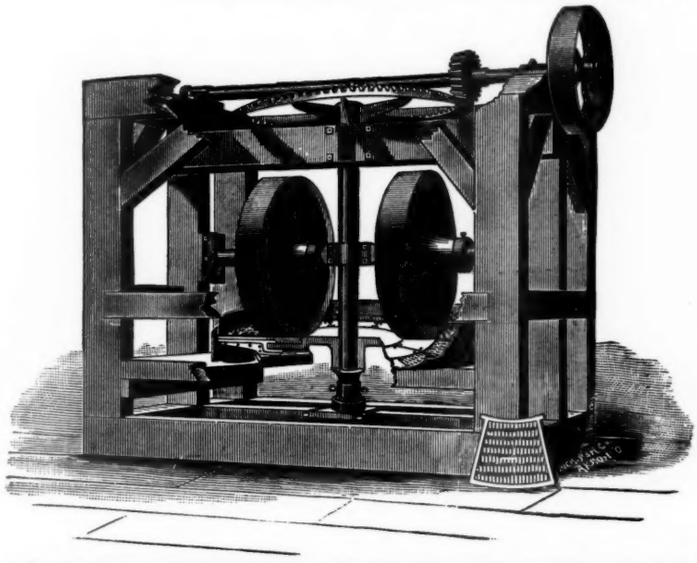

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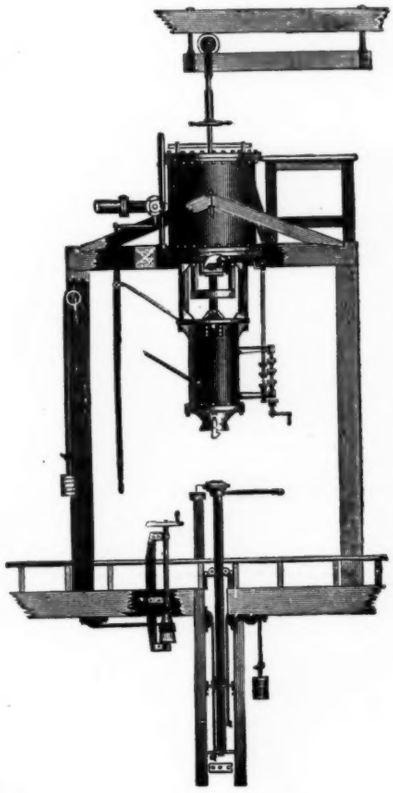

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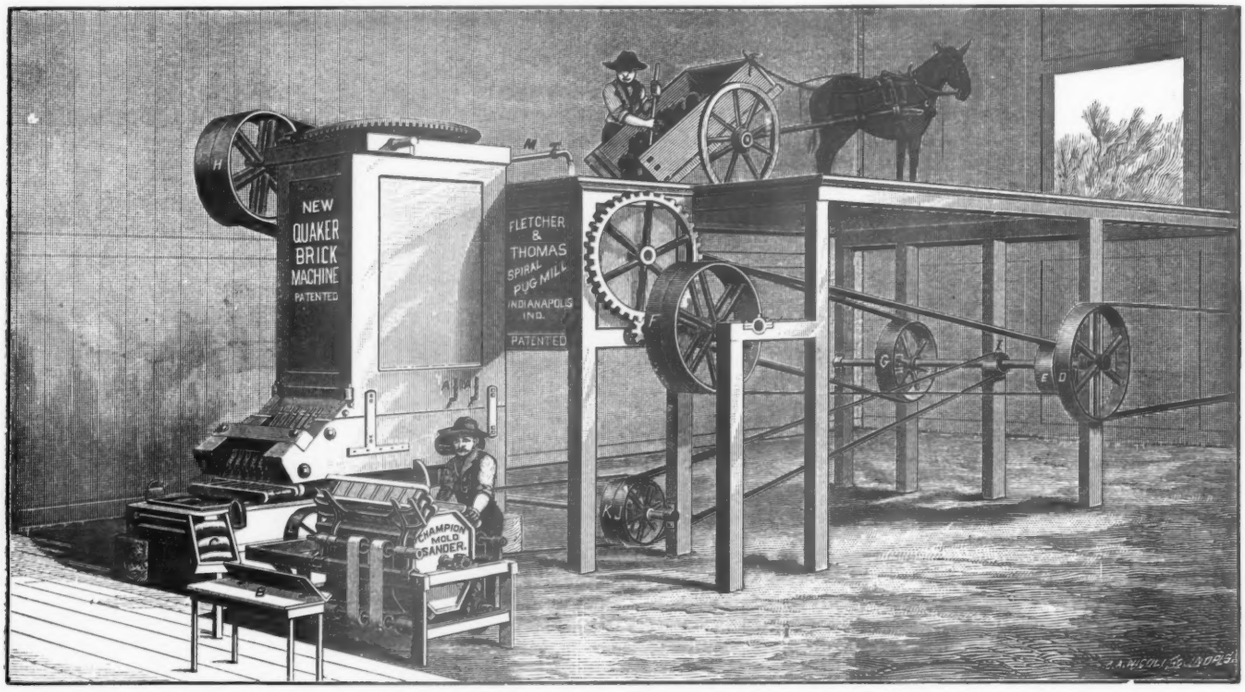

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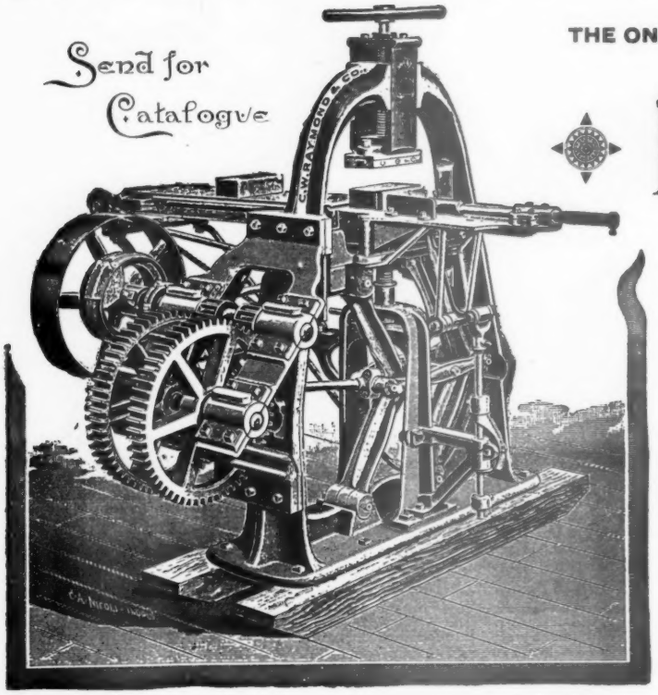

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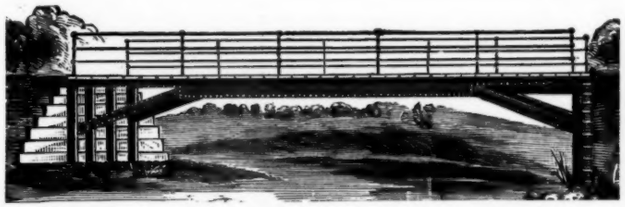

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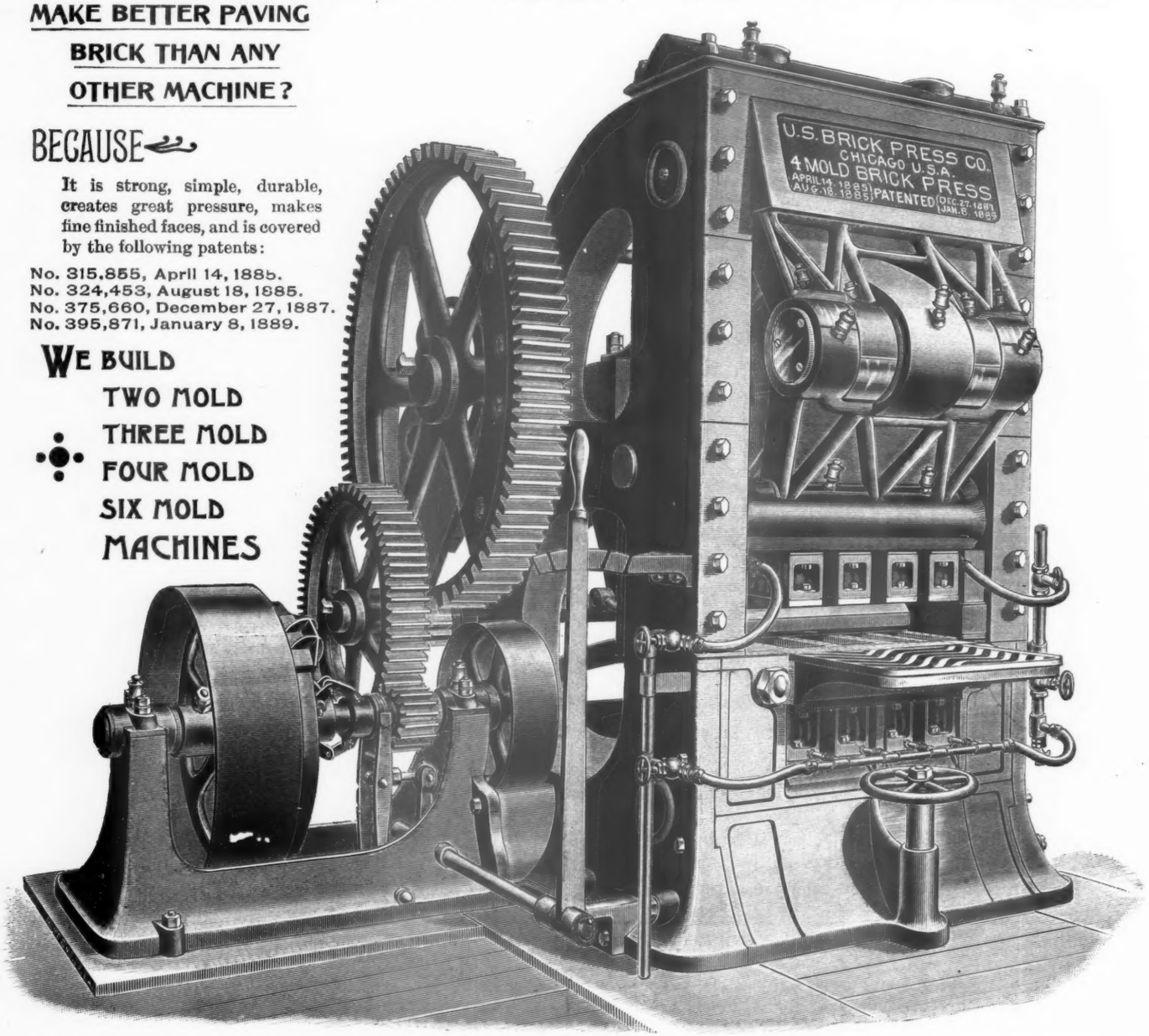

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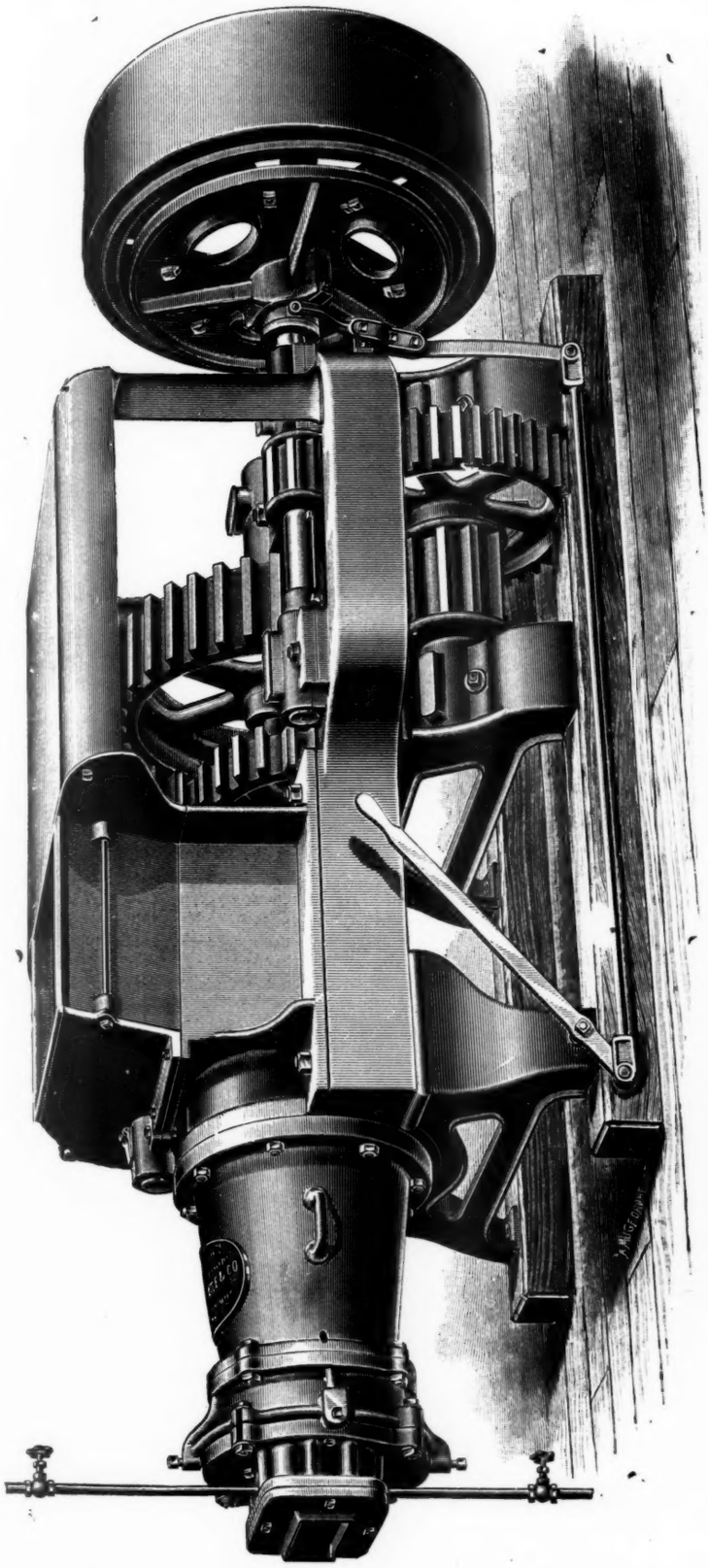

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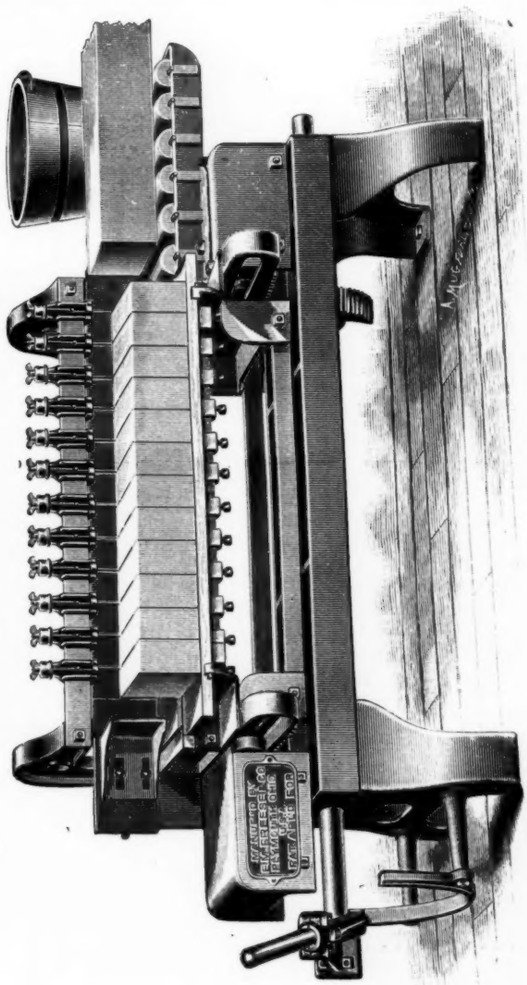

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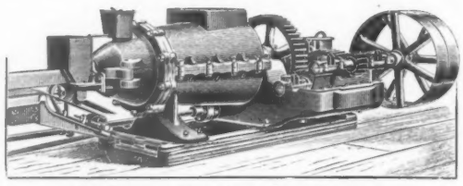

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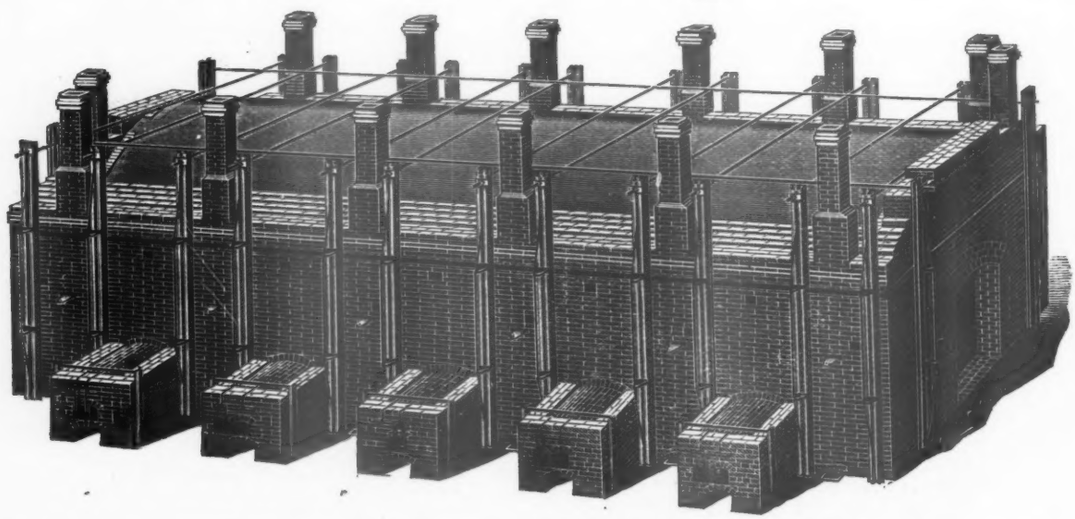

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